



# **MODEL 1700 LIQUID LEVEL INSTRUMENT**

**(LIQUID HELIUM VERSION)**

**INSTALLATION, OPERATION, AND  
MAINTENANCE INSTRUCTIONS**

***American Magnetics, Inc.***

---

P.O. Box 2509, 112 Flint Road, Oak Ridge, TN 37831-2509, Tel: 865-482-1056, Fax: 865-482-5472



**Foreword ..... V**

**Purpose and Scope ..... v**

**Contents of this Manual ..... v**

**General Precautions ..... vi**

**Cryogen Safety Summary ..... viii**

**Safety Legend ..... viii**

**Equipment Warnings ..... ix**

**Instrument Configuration ..... ix**

**Introduction ..... 1**

**Model 1700 Instrument ..... 1**

    Superconducting Level Sensors ..... 1

    Digitally-Controlled ..... 1

    System Flexibility ..... 1

    Display ..... 2

    Intuitive Human-Interface Design ..... 2

    Measurement Flexibility ..... 2

    Real Time Clock ..... 2

    Analog Outputs ..... 2

    Signal Relays ..... 2

    Connectivity ..... 2

**Model 1700 Front Panel Layout ..... 4**

**Model 1700 Rear Panel Layout ..... 5**

**Model 1700 Specifications @ 25°C ..... 6**

**Installation ..... 9**

**Unpacking and Inspecting the Instrument ..... 9**

**Mounting the Model 1700 Instrument ..... 9**

**Liquid Helium Level Sensor Installation ..... 10**

**Connecting the Sensor to the Instrument ..... 11**

    Connecting a Liquid Helium Level Sensor ..... 11

<b>Power Requirements</b> .....	<b>13</b>
<b>0-10 VDC Recorder Output</b> .....	<b>13</b>
<b>4-20 mA Current Loop Output</b> .....	<b>13</b>
<b>Operation</b> .....	<b>15</b>
<b>Energizing the Model 1700 Instrument</b> .....	<b>15</b>
<b>Screen Navigation</b> .....	<b>16</b>
Home Screen Footer .....	16
<b>Navigating the Instrument Menus</b> .....	<b>16</b>
Menu Overview .....	17
Editing a Field .....	19
Menu Navigation .....	20
<b>Superconducting (Liquid Helium) Level</b> .....	<b>21</b>
Configure the instrument to display helium level .....	21
Sensor Burnout Protection .....	23
Sample and Hold Operation .....	24
Other Liquid Helium Functions .....	24
<b>Alarms and Relays</b> .....	<b>25</b>
Level-Based Alarms .....	25
Multiple alarms .....	25
Configuring Alarm Setpoints .....	26
Acknowledging an Alarm .....	26
Muting an Alarm .....	27
<b>Select the appropriate units on the display</b> .....	<b>28</b>
<b>Analog output signals</b> .....	<b>28</b>
Configuring the Analog Outputs .....	28
<b>Ethernet Connectivity</b> .....	<b>29</b>
IP Addressing Scheme .....	29
<b>Abnormal Operation</b> .....	<b>30</b>
Dirty Helium Sensor Operational Mode .....	30
Resetting the Instrument to Factory Defaults .....	30
<b>Shutting the Instrument Down</b> .....	<b>31</b>

<b>Calibration .....</b>	<b>33</b>
<b>Setting the System Date and Time .....</b>	<b>33</b>
<b>Superconductivity-Based (Liquid Helium) Level Calibration .....</b>	<b>35</b>
Verify the Liquid Helium Sensor Type .....	35
Sensor Sample Interval .....	36
Sensor Active Length .....	37
Continuous Measure Time Limit .....	37
Sensor Name .....	38
<b>Remote Interface Reference .....</b>	<b>39</b>
<b>SCPI Command Summary .....</b>	<b>39</b>
<b>RS-232 Configuration .....</b>	<b>43</b>
Serial port connector and cabling .....	43
Command/return termination characters .....	44
<b>Ethernet Configuration .....</b>	<b>44</b>
Ethernet Connector .....	44
Termination Characters .....	44
Port Assignment .....	44
<b>Command Reference .....</b>	<b>45</b>
System Related Commands .....	45
Display Configuration Commands and Queries .....	47
Alarm Configuration Commands and Queries .....	48
Measurement Commands and Queries .....	49
Fill Control and Queries .....	50
HE Channel Sampling Commands and Queries .....	51
Assignment Commands and Queries .....	51
HE Channel Calibration Commands and Queries .....	52
Remote Units Commands and Queries .....	52
<b>Error Codes .....</b>	<b>53</b>
<b>Legacy Command Reference .....</b>	<b>54</b>
Commands for Controlling the Units of Measurement .....	54
Commands for Configuring Permanent Memory .....	55
Querying the Configuration .....	56
Returning a Level Measurement .....	56

<b>Service and Repair .....</b>	<b>57</b>
<b>Cleaning .....</b>	<b>57</b>
<b>User Replaceable Parts .....</b>	<b>57</b>
<b>Battery Replacement. ....</b>	<b>58</b>
Tools Required .....	58
Procedure .....	58
<b>Fuse Replacement. ....</b>	<b>59</b>
Tools Required .....	59
Procedure .....	59
<b>Firmware Upgrade Via Micro-SD Card Replacement. ....</b>	<b>60</b>
Tools Required .....	60
Procedure .....	60
<b>Appendix .....</b>	<b>63</b>
<b>Serial (RS-232) Connector .....</b>	<b>63</b>
<b>Ethernet Connector .....</b>	<b>64</b>
<b>Liquid Helium Connector J1 Wiring .....</b>	<b>65</b>
<b>Aux I/O Connector. ....</b>	<b>66</b>
<b>Dielectric Constants for Cryogenic Liquids .....</b>	<b>67</b>
<b>Troubleshooting .....</b>	<b>68</b>
Instrument Displays “LOSS OF SENSOR” Condition for LHe Level Measurement .....	68
Instrument Displays “SENSOR PROTECTED” Condition for LHe Measurement. ....	68
<b>Firmware Licenses .....</b>	<b>69</b>
<b>Glossary .....</b>	<b>77</b>
<b>Abbreviations and Acronyms .....</b>	<b>77</b>
<b>Index.....</b>	<b>79</b>

---

# FOREWORD

---

---

## PURPOSE AND SCOPE

---

This manual contains the operation and maintenance instructions for the American Magnetics, Inc. Model 1700 Liquid Level Control Instrument and outlines applications for various system configurations. Since it is not possible to cover all equipment combinations for all magnet systems, only the most common configurations are discussed. The user is encouraged to contact an authorized AMI Technical Support Representative for information regarding specific configurations not explicitly covered in this manual. This manual refers to the instrument as configured for liquid helium operation.

---

## CONTENTS OF THIS MANUAL

---

**Introduction** describes the functions, specifications, and characteristics of the Model 1700 Instrument. It provides illustrations of the front and rear panel layouts as well as documenting the performance specifications. Additional information is provided in the form of system block diagrams.

**Installation** describes how the Model 1700 Instrument is unpacked and installed in conjunction with ancillary equipment in typical systems. Block-level diagrams document the interconnects for various system configurations.

**Operation** describes how the Model 1700 Instrument is used to monitor liquid helium levels.

**Calibration** describes the calibration technique for liquid helium level sensors.

**Remote Interface Reference** documents all remote commands and queries available through the Model 1700 Instrument RS-232 and Ethernet interfaces. A quick-reference summary of commands is provided as well as a detailed description of each.

The **Appendix** and **Glossary** sections support the information in the sections listed above. See the Appendix section when referenced from other sections. See the Glossary for any words or acronyms presented in the above sections, requiring a more complete understanding.

---

## GENERAL PRECAUTIONS

---

### Cryogen Safety

The two most common cryogenic liquids used in superconducting magnet systems are nitrogen and helium. Both of these cryogens are extremely cold at atmospheric pressure ( $-321^{\circ}\text{F}$  and  $-452^{\circ}\text{F}$ , respectively). The following paragraphs outline safe handling precautions for these liquids.

Personnel handling cryogenic liquids should be thoroughly instructed and trained as to the nature of the liquids. Training is essential to minimize accidental spilling. Due to the low temperature of these materials, a cryogen spilled on many objects or surfaces may damage the surface or cause the object to shatter, often in an explosive manner.

Inert gases released into a confined or inadequately ventilated space can displace sufficient oxygen to make the local atmosphere incapable of sustaining life. Liquefied gases are potentially extreme suffocation hazards since a small amount of liquid will vaporize and yield a very large volume of oxygen-displacing gas. Always ensure the location where the cryogen is used is well ventilated. Breathing air with insufficient oxygen content may cause unconsciousness without warning. If a space is suspect, purge the space completely with air and test before entry. If this is not possible, wear a forced-air respirator and enter only with a co-worker standing by wearing a forced-air respirator.

Cryogenic liquids, due to their extremely low temperatures, will also burn the skin in a similar manner as would hot liquids. Never permit cryogenic liquids to come into contact with the skin or allow liquid nitrogen to soak clothing. Serious burns may result from careless handling. Never touch uninsulated pipes or vessels containing cryogenic liquids. Flesh will stick to extremely cold materials. Even nonmetallic materials are dangerous to touch at low temperatures. The vapors expelled during the venting process are sufficiently cold to burn flesh or freeze optic tissues. Insulated gloves should be used to prevent frost-bite when operating valves on cryogenic tanks. Be cautious with valves on cryogenic

systems; the temperature extremes they are typically subjected to cause seals to fail frequently.

In the event a person is burned by a cryogen or material cooled to cryogenic temperatures, the following first aid treatment should be given pending the arrival and treatment of a physician or other medical care worker:

1. If any cryogenic liquid contacts the skin or eyes, immediately flush the affected area gently with tepid water (102°F – 105°F, 38.9°C – 40.5°C) and then apply cold compresses.
2. Do not apply heat. Loosen any clothing that may restrict circulation. Apply a sterile protective dressing to the affected area.
3. If the skin is blistered or there is any chance that the eyes have been affected, get the patient immediately to a physician for treatment.

Containers of cryogenic liquids are self pressurizing (as the liquid boils off, vapor pressure increases). Hoses or lines used to transfer these liquids should never be sealed at both ends (i.e. by closing valves at both ends).

When pouring cryogenic liquids from one container to another, the receiving container should be cooled gradually to prevent damage by thermal shock. The liquid should be poured slowly to avoid spattering due to rapid boil off. The receiving vessel should be vented during the transfer.

Introduction of a substance at or near room temperature into a cryogenic liquid should be done with great caution. There may be a violent gas boil-off and a considerable amount of splashing as a result of this rapid boiling. There is also a chance that the material may crack or catastrophically fail due to forces caused by large differences in thermal contraction of different regions of the material. Personnel engaged in this type of activity should be instructed concerning this hazard and should always wear a full face shield and protective clothing. If severe spraying or splashing could occur, safety glasses or chemical goggles along with body length protective aprons will provide additional protection.

The properties of many materials at extremely low temperatures may be quite different from the properties that these same materials exhibit at room temperatures. Exercise extreme care when handling materials cooled to cryogenic temperatures until the properties of these materials under these conditions are known.

Metals to be used for use in cryogenic equipment application must possess sufficient physical properties at these low temperatures. Since ordinary carbon steels, and to somewhat a lesser extent, alloy steels, lose much of their ductility at low temperatures, they are considered unsatisfactory and sometimes unsafe for these applications. The

austenitic Ni-Cr alloys exhibit good ductility at these low temperatures and the most widely used is 18-8 stainless steel. Copper, Monel<sup>®</sup>, brass and aluminum are also considered satisfactory materials for cryogenic service.

---

## CRYOGEN SAFETY SUMMARY

---

Cryogenic systems are complex systems with the potential to seriously injure personnel or equipment if not operated according to procedures. The use of safety mechanisms (pressure relief valves, rupture disks, etc.) in cryogenic systems is usually necessary.

### Recommended Safety Equipment

The use of proper safety equipment is necessary. Such equipment may include, but not limited to, the following items:

- First Aid kit
- Fire extinguisher rated for class C fires
- Cryogenic gloves
- Face shield
- Signs to indicate that there are potentially dangerous cryogenics in use in the area.

---

## SAFETY LEGEND

---



Instruction manual symbol: the product is marked with this symbol when it is necessary for you to refer to the instruction manual in order to protect against damage to the product or personal injury.



Hazardous voltage symbol.



Alternating Current (Refer to IEC 417, No. 5032).



Off (Supply) (Refer to IEC 417, No. 5008).



On (Supply) (Refer to IEC 417, No. 5007).

### **WARNING**

The Warning sign denotes a hazard. It calls attention to a procedure or practice, which if not correctly adhered to, could result in personal injury. Do not proceed beyond a Warning sign until the indicated conditions are fully understood and met.

**The Caution sign denotes a hazard. It calls attention to an operating procedure or practice, which if not adhered to, could cause damage or destruction of a part or all of the product. Do not proceed beyond a Caution sign until the indicated conditions are fully understood and met.**

---

## EQUIPMENT WARNINGS

---

Before energizing the equipment, the earth ground of the power receptacle must be verified to be at earth potential and able to carry the rated current of the power circuit. Using extension cords should be avoided. However, if an extension cord must be used, insure the ground conductor is intact and the cord is capable of carrying the rated current without excessive voltage drop.

In the event that the ground path becomes less than sufficient to carry the rated current of the power circuit, the equipment should be disconnected from power, labeled as unsafe, and removed from place of operation.

Do not operate this equipment in the presence of flammable gases. Doing so could result in a life-threatening explosion.

Do not modify this equipment in any way. If component replacement is required, return the equipment to AMI facilities as described in the troubleshooting section of this manual.

If used in a manner not specified in this manual, the protection provided by the design, manufacture and documentation of the Model 1700 Instrument may be impaired.

---

## INSTRUMENT CONFIGURATION

---

The Model 1700 Instrument is configured at time of purchase as one in several ways:

- 
- As a helium level instrument for level sensors with active length up to 80 inches (203 cm) for either 4.2K or 2K LHe.

Every configuration may be further customized by the following options:

- Table top, single rack mounting, dual rack mounting.
- Line cord: North American, European Schuko, Australia/NZ, China, UK, pig-tailed ends.

The instrument part number, shown on the serialization label located on the underside of the instrument, as well as in a field in the instrument Menu, identifies the configuration according to the following key:

**1700-A-B-C-D-E** where

**A** indicates the mounting method:

Tbl = tabletop

SR19L = single rack mounted, 19" wide rack standard, instrument on left side

SR19R = single rack mounted, 19" wide rack standard, instrument on right side

SR10L = single rack mounted, 10" wide rack standard, instrument on left side

SR10R = single rack mounted, 10" wide rack standard, instrument on right side

DRL = dual rack mount, 19" wide rack standard, instrument on left side

DRR = dual rack mount, 19" wide rack standard, instrument on right side

**B** indicates the line cord shipped with the instrument:

N = North American

E = European, Schuko

A = Australian/New Zealand

C = Chinese

U = United Kingdom

P = India/pigtailed

**C** indicates the capacitance-based level configuration:

N = not configured

**D** indicates the helium level configuration:

He2K = 2K helium for sensors

He4K = 4.2K helium for sensors

N = not configured

The sensor active length and length units are appended to the configuration code, ie ...He2K-40IN-...

**E** is used to denote any instrument customization:

S = standard (no customization)

C = instrument modified.



# INTRODUCTION

---

---

## MODEL 1700 INSTRUMENT

---

The AMI Model 1700 Liquid Level Instrument is a sophisticated measurement and control instrument which provides monitoring liquid helium level sensors as inputs and provides for automatic level control based on user set parameters.

At time of purchase, the Model 1700 will be configured as:

- A liquid helium level instrument/controller.

The Model 1700 instrument will measure liquid helium level using a superconducting level sensor. The instrument will be factory configured for either 4.2K or 2K liquid helium level sensors at time of purchase.

---

### SUPERCONDUCTING LEVEL SENSORS

The instrument can be used with a superconducting level sensor to measure liquid helium levels. The instrument will be configured at the factory to measure liquid helium levels. The instrument is configured for level sensors of active lengths of 1 - 80 inches. The instrument can be used with either 4.2K or 2K level sensor types but must be configured and calibrated at time of purchase for the LHe level sensor type.

---

### DIGITALLY- CONTROLLED

The Model 1700 contains a microcomputer which controls analog data conversion, display/keypad functions, communications I/O, dry contact closures, generation of analog output signals and relay control of a mains power outlet for solenoid valve autofill applications.

---

### SYSTEM FLEXIBILITY

The Model 1700 instrument incorporates data converters to translate signals between the analog and digital domains. Precision instrumentation techniques and potentiometer-free designs are

employed throughout the Model 1700 Instrument to ensure long term stability and accurate signal translation for a wide range of conditions.

---

## DISPLAY

The Model 1700 Instrument has a 4.3" diagonal measure TFT (Thin Film Transistor) color liquid crystal display of 480 x 272 pixels. The display has a 4-wire resistive touch overlay for easy operator input.

---

## INTUITIVE HUMAN-INTERFACE DESIGN

The Model 1700 instrument is designed to simplify the touch-screen based user interface. All functions were analyzed and subsequently programmed so that the most commonly used functions are addressed with the least number of keystrokes. The menus are presented in a logical fashion so that the operation of the Model 1700 is intuitive to the user.

---

## MEASUREMENT FLEXIBILITY

Set points can be assigned to control two dry-contact relay outputs. The make or break function of each relay can be set independently. A solid-state relay allows mains power to be switched according to set points to operate a solenoid-operated valve or other load.

---

## REAL TIME CLOCK

The Model 1700 Instrument incorporates a real time clock with automatic daylight savings time adjustment (if desired).

---

## ANALOG OUTPUTS

The Model 1700 Instrument has two analog outputs, a 0-10  $V_{DC}$  voltage output and a 4-20  $mA_{DC}$  current loop output. The 4-20  $mA_{DC}$  loop output has 1500  $V_{PK}$  circuit isolation. The outputs can be used simultaneously.

---

## SIGNAL RELAYS

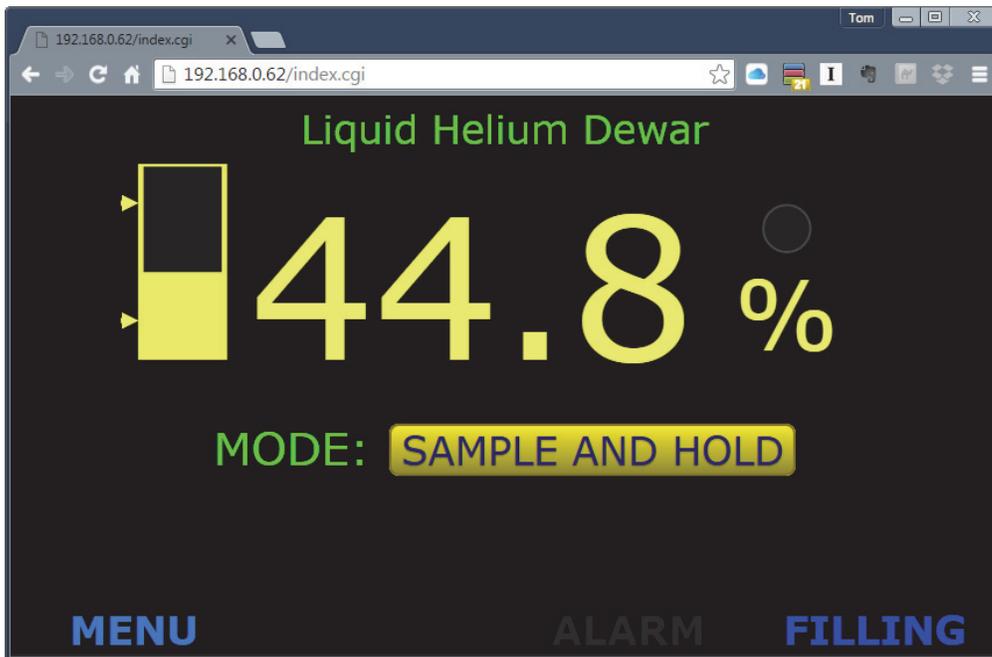
The Model 1700 Instrument has two signal relays that change state based on a measured input. The set points of these relays are user-selectable as is their function, alarm on level above or below set point.

---

## CONNECTIVITY

The Model 1700 Instrument has a 10Base-T Ethernet connection as well as a 115,200 baud RS-232 port for connecting to other equipment. The instrument communicates with a SCPI-based command set. The command set is 100% backward compatible with the AMI Model 135, 136, 185, and 186 instruments when configured as a single channel instrument. When configured as a dual channel instrument, additional commands are incorporated into the command set.

The Model 1700 Instrument allows for remote operation with an external browser via TCP/IP connection. All commands that are available by touching the local screen are available via the web browser



Model 1700 Helium Instrument Via Web Browser

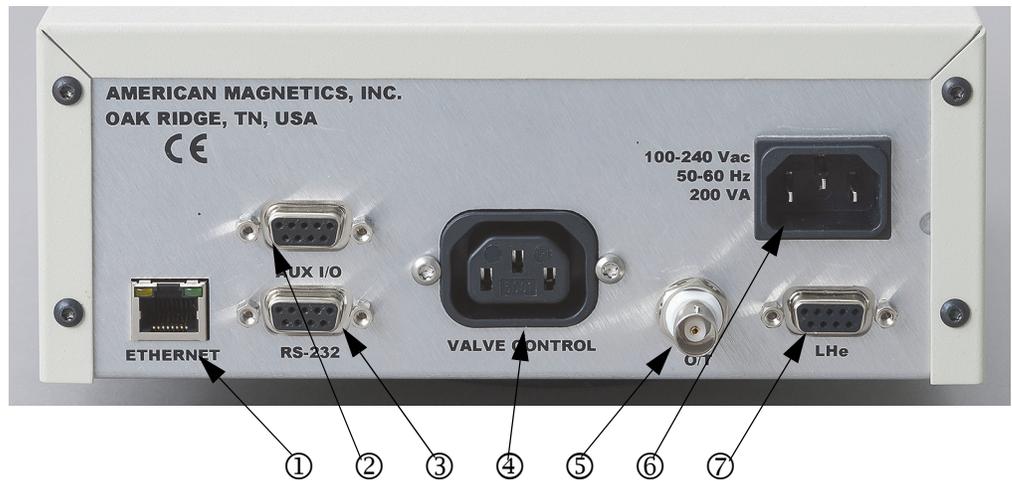
**NOTE** Using a web browser to connect to the instrument allows different browser sessions to display different information. For instance, one browser window can display helium level only and a second browser window can display nitrogen level only. The instrument can be configured independently as well since it's display is also a browser. Refer to "Configure the instrument to display helium level" on page 21.

## MODEL 1700 FRONT PANEL LAYOUT



Model 1700 Front View; Dual Channel Instrument Shown

## MODEL 1700 REAR PANEL LAYOUT



### Model 1700 Rear Panel Description

	<b>1</b> Computer Network Connector
	<b>2</b> Aux I/O Connector
	<b>3</b> RS-232 Serial Connector
	<b>4</b> Switched Valve Outlet Socket
<b>LN2 VERSION</b>	<b>5</b> Capacitive Sensor Input Connector
	<b>6</b> Mains Power Entry Connector
<b>LHe OPTION</b>	<b>7</b> LHe Level Sensor Connector

## MODEL 1700 SPECIFICATIONS @ 25°C

### System Architecture

Display:	4.3" 24-bit color TFT display, 480x272 pixel with resistive touch screen
Sensor Types:	Superconductivity-based liquid level
Maximum Length Readout:	Superconductivity-based liquid level (LHe) up to 80 in
Superconducting (LHe) Sensor Excitation:	Continuous reading or Sample and Hold mode
System Operating Firmware Storage:	Flash memory
System Clock:	Real time clock with automatic DST adjustment
Display Measurement Units:	Liquid level in cm, in or percent

### Level Measurement

Resolution:	0.1%, 0.1 cm, 0.1 in
Accuracy:	±0.5% of active sensor length
Linearity:	±0.1% or 1 mm (whichever is greater)
Superconducting LHe Sensor Current:	4.2K LHe Temperature: 75 mA <sub>DC</sub> nominal 2K LHe Temperature: 57 mA <sub>DC</sub> nominal
Dirty Sensor Mode:	Approximately twice normal current for 1 second prior to normal measurement excitation
Superconducting LHe Sensor Voltage:	4.2K Sensor: approximately 0.87 V <sub>DC</sub> per inch of sensor active length @ 10K 2K Sensor: approximately 0.66 V <sub>DC</sub> per inch of sensor active length @ 10K
Maximum Open Circuit Voltage:	96 V <sub>DC</sub> , galvanically isolated

### Operating Parameters

Alarm Set Points:	0% to 100%, adjustable; Alarm condition settable to above or below set point
Sample and Hold Period:	1 second to 86,400 seconds (24 hrs)
Audible alarm:	3500 ± 500 Hz, 73 to 86 dB(A)

### Analog Outputs

Output Types:	0-10 V <sub>DC</sub> and simultaneous 4 - 20 mA <sub>DC</sub>
4-20 mA Current Loop Power Supply Voltage:	12-32 V <sub>DC</sub>
0-10 V <sub>DC</sub> Recorder Output Load:	50k ohms or greater
0-10 V <sub>DC</sub> Recorder Output 0% Max Offset:	+20 mV
0-10 V <sub>DC</sub> Recorder Output 100% Max Error:	± 80 mV
Voltage and Current Output Converter Resolution:	12 bits
Integral Non-linearity:	±1LSB

Differential Non-linearity<sup>a</sup>: | ±1LSB

**Relays**

<p>№1 and/or №2 (W171DIP-7, or equivalent):</p>	<p>Contact Form: 1 Form A (SPST-NO)                  Maximum Switched Power: 0.29 W                  Maximum Switched Current: 3 A                  Switching Voltage: 60 V<sub>AC</sub> / 100 V<sub>DC</sub></p>
<p>Level Control:</p>	<p>Rated Load Voltage: 2 A at 100 to 240 V<sub>AC</sub>                  Load Voltage Range: 75 to 264 V<sub>AC</sub> (Line Dependent)                  Load Current: 0.1 to 2 A                  Surge Current: 30 A (60 Hz, 1 cycle)</p>

**Communication Protocol**

<p>Host Computer Network Protocol:</p>	<p>10Base-T TCP/IP and RS-232 115,200 baud</p>
<p>IP Addressing:</p>	<p>DHCP or static, IPv4</p>
<p>Network Connectivity and Traffic Indication:</p>	<p>Link and Activity LEDs on instrument rear panel</p>
<p>RS-232 Connector Specifications:</p>	<p>9-pin D-sub female connector to connect standard DTE 9-pin D-sub male connector using a standard straight cable</p>
<p>Communication Command Set:</p>	<p>SCPI-based. 100% backward compatible with the Model 134, 135, 136 instruments.</p>

**Power Requirements**

<p>Primary:</p>	<p>100-240 ±10% V<sub>AC</sub>, 50-60 Hz, 2.2 A maximum (200 VA plus sum of controller output)</p>
<p>Backup Battery for RTC:</p>	<p>CR2032</p>

**Physical**

<p>Dimensions<sup>b</sup>:</p>	<p>Table top configuration:                  3.8" H x 8.4" W x 11.4" D                  [97 mm H x 213 mm W x 290 mm D]                  Single rack mount configuration: 3.5" H x 19.0" W x 11.4" D                  [89 mm H x 483 mm W x 290 mm D]</p>
<p>Weight:</p>	<p>Table-top configuration: 3.3 lbm [1.5 kG];                  Single rack-mount configuration: 4.0 lbm [1.8 kG]</p>

**Environmental Limits**

<p>Ambient Temperature:</p>	<p>Operating: 0°C to 40°C                  [32°F to 104°F];                  Non-operating: -20 °C to 60 °C                  [-4 °F to 140 °F]</p>
<p>Relative Humidity:</p>	<p>0 to 95%; non-condensing</p>
<p>Maximum Instrument Background Field:</p>	<p>Gauss (TBD)</p>

**Standards**

Test Standards	
	Testing of Equipment for Measurement, Control, and Laboratory Use (IEC 61326-1:2012, EN 61326-1)
	Electrostatic Discharge (ESD) (EN 61000-4-2)
	Radiated Immunity (EN 61000-4-3)
	Fast Transient Burst (EN 61000-4-4)
	Surges (EN 61000-4-5)
	Conducted Immunity (EN 61000-4-6)
	Power Frequency Magnetic Field (EN 61000-4-8)
	Voltage Dips and Interrupts (EN 61000-4-11)
	Harmonics (EN 61000-3-2)
	Flicker (EN 6100-3-3)
	Conducted Emissions (EN 55011/IEC/CISPR 11)
	Radiated Emissions (EN 55011/IEC/CISPR 11)
	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use (IEC 61010-1)

- a. Guaranteed monotonic over operating temperature range
- b. H = height; W = width; D = depth

---

# INSTALLATION

---

**WARNING** Equipment warnings apply to all system installation configurations. Refer to “Equipment Warnings” on page ix, in the Foreword to be familiar with the safety requirements for a system installation.

---

## UNPACKING AND INSPECTING THE INSTRUMENT

---

Carefully remove the equipment, interconnecting cabling, and documentation CD (and/or printed material) from the shipping carton, and remove all packaging material.

**NOTE** If there is any shipping damage, save all packing material and contact the shipping company representative to file a damage claim. Do not return to AMI unless prior authorization has been received.

---

## MOUNTING THE MODEL 1700 INSTRUMENT

---

If the Model 1700 Instrument is to be used as a table top model, place the equipment on a flat, secure surface.

If the Model 1700 Instrument is to be rack mounted, install it in a 19" wide instrument rack using the mounting hardware supplied by the rack cabinet manufacturer. The feet on the bottom of the instrument may be removed to facilitate rack mounting. Secure the front panel to the rack rail in each of the four corners.

## LIQUID HELIUM LEVEL SENSOR INSTALLATION

1. The sensor must be mounted with the electrical leads at the top.
2. For minimum losses, mount the liquid helium sensor so that warm helium gas rising from the sensor can pass directly out of the dewar without contacting surfaces at 4.2K.
3. Do not mount the sensor in restricted areas (tubes, etc.) where the liquid level around the sensor might be depressed by pressure differences in the gas. Do not cover the holes in the sensor.
4. The sensor may be mounted by taping or clipping it to an appropriate support structure. Do not exert excess pressure on the sensor with the mounting device to avoid crushing the tube. Avoid constraining both ends of the sensor and allow for contraction of the sensor during cooldown.

**CAUTION** Do not operate the sensor in a vacuum. Operating the sensor in a vacuum may cause thermal damage and/or destruction of the superconducting filament sensor. Do not inadvertently turn the instrument on with the sensor in an evacuated chamber. Operation in pumped liquid helium environments is acceptable to 1K as long as liquid helium is present.

5. Avoid installing in a location where icing (frozen water or gas) may occur since ice formations may cause erratic operation. Ice formation on the NbTi filament may stop the propagation of the normal (resistive) zone before it actually reaches the liquid/gas interface. This will give an indication of a higher helium level than actually exists.
6. Connect the sensor to the Model 1700 LHe Level Sensor connector on the instrument rear panel (refer to “Liquid Helium Connector J1 Wiring” on page 65). The liquid helium level sensor leads are color coded:

### LHe Level Sensor Wire Identification

Wire Function	Teflon Insulation Color	Formvar Insulation Color	Instrument Connector Pin
I+	Red	Red	1
V+	Blue	Green	8
V-	Yellow	Natural	6
I-	Black	Blue	7

---

## CONNECTING THE SENSOR TO THE INSTRUMENT

---

---

### CONNECTING A LIQUID HELIUM LEVEL SENSOR

The instrument is connected to the liquid helium level sensor with a 4-conductor cable which has a 9-pin D-sub male connector on one end that mates with the connector used at the instrumentation feed through connector on the cryostat. This connector is typically a multi-pin circular type connector.

Prepare the sensor to be connected to the instrument by soldering the sensor leads to a male 9-pin D-Sub connector which will connect to the female 9-pin D-Sub connector on the transmitter. Refer to the *Appendix* of this manual and the AMI sensor manual for the proper pin out and wire color connections. Connect the sensor to the connector on the transmitter.

**WARNING**

Although the sensor connector terminals are isolated from earth ground and therefore touching one terminal is not hazardous, the voltage between terminals is at a hazardous potential. The sensor connector is for use with an AMI LHe sensor and the wiring for the sensor is to have no live parts which are accessible. Conductors connected to its terminals must be insulated from user contact by basic insulation rated for 150 V<sub>AC</sub> (Category I).

The lead wire for the sensor may be sized by the following equation:

$$R = 420 - 5.21L$$

where  $R$  is the maximum allowable resistance (in ohms) for each lead wire from the instrument to the sensor, and  $L$  is the active length of the

connected helium level sensor in inches. Tables for active sensor length vs. lead wire distance are provided below.

**Minimum recommended wire gauge for copper lead wire**

Distance	R=367	R=315	R=263	R=211	R=107	R=3.2
	L=10"	L=20"	L=30"	L=40"	L=60"	L=80"
10 ft.	36 AWG				36 AWG	34 AWG
20 ft.						30 AWG
30 ft.						28 AWG
40 ft.						27 AWG
50 ft.						24 AWG
100 ft.						22 AWG
200 ft.					32 AWG	16 AWG
500 ft.						16 AWG

---

## POWER REQUIREMENTS

---

**WARNING**

The Model 1700 Instrument operates on 50-60 Hz power and may be powered from 100-240 VAC. Insure that the input ground terminal is connected securely to an external earth ground.

Ensure the detachable mains supply cord is of suitable rating, i.e. 10 A (min) at 125 VAC for North America.

Ensure the power switch is in the OFF (●) position. Plug the Model 1700 Instrument line cord into the power entry module on the instrument rear panel and into the appropriate power receptacle.

---

## 0-10 V<sub>DC</sub> RECORDER OUTPUT

---

The Model 1700 instrument provides a 0-10 V<sub>DC</sub> output on the AUX I/O connector (refer to “Aux I/O Pin Definitions” on page 66) corresponding to 0-100% of liquid level. This output can be assigned to either level measurement channel (refer to “Analog output signals” on page 28). Connect the voltage output on the AUX I/O connector to a suitable receiver being careful not to exceed the impedance restrictions (refer to “Model 1700 Specifications @ 25°C” on page 6).

---

## 4-20 mA CURRENT LOOP OUTPUT

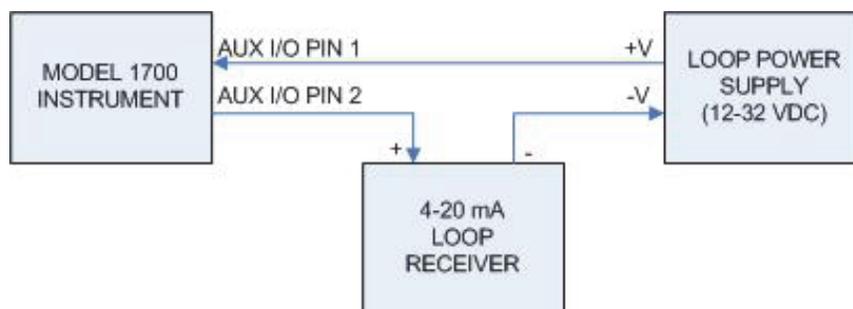
---

The Model 1700 instrument provides a 4-20 mA<sub>DC</sub> output on the AUX I/O connector (refer to “Aux I/O Pin Definitions” on page 66) corresponding to 0-100% of liquid level. This output can be assigned to either level measurement channel (refer to “Analog output signals” on page 28).

The instrument requires an external power supply for current loop operation. Connect a suitable power supply as shown below.

**CAUTION**

It is extremely important to observe all polarities and to not exceed +32VDC for the loop power supply in order to prevent damage to the 4-20mA driver circuit.



# OPERATION

This section describes the operation of the Model 1700 Instrument.

## ENERGIZING THE MODEL 1700 INSTRUMENT

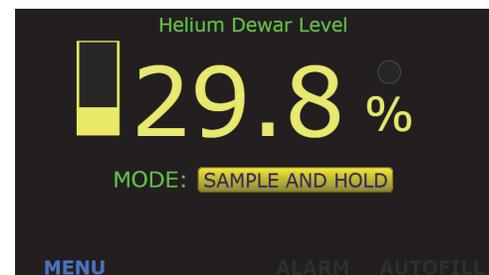
1. Turn the power switch on the front panel of the instrument to the On (I) position. The display will briefly show the AMI logo and then boot information.
2. The boot process takes approximately 30 seconds, This time can be longer (approximately 2 minutes) if the instrument has been configured for a network connection and then is booted without the network present.

**NOTE** If the instrument was purchased with a level sensor, the instrument will be configured and calibrated at the factory.

3. When the boot process is complete, the instrument will display the home (level) screen.

h. The display will look similar to the following:

- i. If the instrument requires calibration<sup>1</sup>, refer to the following chapter to calibrate the instrument with an AMI level sensor.



LHe Home Screen

1. If the instrument was purchased with level sensor(s), the instrument will be shipped set up and calibrated.

## SCREEN NAVIGATION

### HOME SCREEN FOOTER

Every screen has a footer. The level home screen (refer to Figure as an example) displays both level information and buttons in the footer to navigate to other screens.

The home screen footer appears as shown at right:



**Model 1700 Instrument Home Screen Footer**

No.	Name	Function
①	MENU	Takes the user to the menu screen
②	ALARM	When illuminated, displays an alarm condition
③	AUTOFILL	Indicates the condition of the autofill function

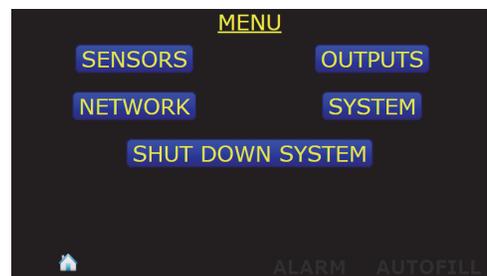
## NAVIGATING THE INSTRUMENT MENUS

The menu system is invoked by pressing the Menu button in the lower left corner of the instrument level display screen.



**MENU button on HOME screen**

When invoked, the MENU screen will be displayed:



**MENU Selection Screen**

Pressing the Home icon in the lower left corner of the screen will display the Home screen.



**HOME button on MENU screen**

Once a MENU has been chosen, a back button will be presented to the right of the Home icon. This button will return the user to the previously displayed screen.



**BACK button**

## MENU OVERVIEW

The Model 1700 Instrument displays menus on the graphic display to the left of the keypad. Press **MENU** on the menu keypad to display options on the graphic display. Menu options are listed in the table below.

**NOTE** The following table shows all menu choices, some of which will not be shown based on the instrument configuration.

**Model 1700 Helium Level Instrument Menu Structure**

Menu Label	Function	Field Type
OUTPUTS	ALARM RELAY No.1 SOURCE:	Toggles between: DISABLED, HELIUM
	(ALARM RELAY No. 1) SETPOINT:	Data entry <value> %
	(ALARM RELAY No. 1) ALARM WHEN LEVEL <state>	Toggles between: ≤, ≥ SETPOINT
	ALARM RELAY No.2 SOURCE:	Toggles between: DISABLED, HELIUM
	(ALARM RELAY No. 2) SETPOINT:	Data entry <value> %
	(ALARM RELAY No. 2) ALARM WHEN LEVEL <state>	Toggles between: ≤, ≥ SETPOINT
	0-10 Vdc SOURCE:	Toggles between: DISABLED, HELIUM
	4-20 mA SOURCE:	Toggles between: DISABLED, HELIUM
NETWORK	ADDRESS: <value>	Data entry or Information
	NETMASK: <value>	Data entry or Information
	GATEWAY: <value>	Data entry or Information
	ADDRESSING:	Toggles between: DISABLED, STATIC, DYNAMIC
	MAC ADDRESS:	Information: <value>

**Model 1700 Helium Level Instrument Menu Structure**

Menu Label	Function	Field Type
SYSTEM (page 1)	HELIUM SENSOR NAME:	Data entry: <value>
	SYSTEM DATE & TIME:	Information: <values>
	(SYSTEM DATE & TIME) SET	Transfer to another screen
	(SYSTEM SETTINGS) PAGE 2	Transfer to another screen
SYSTEM: DATE & TIME (page 4)	SYSTEM DATE AND TIME: YEAR	Data entry
	SYSTEM DATE AND TIME: MONTH	Data entry
	SYSTEM DATE AND TIME: DAY	Data entry
	SYSTEM DATE AND TIME: HOUR	Data entry
	SYSTEM DATE AND TIME: MIN	Data entry
SYSTEM (page 2)	SERIAL NUMBER:	Information: <value>
	HARDWARE VERSION:	Information: <value>
	DATE OF MANUFACTURE:	Information: <value>
	FIRMWARE VERSION:	Information: <value>
	HELIUM POWER SUPPLY:	Information: STD, XL
	RESET INSTRUMENT TO FACTORY DEFAULTS	Transfer to another screen
SYSTEM (page 3)	RESET INSTRUMENT	Performs a function
CALIBRATE TOUCH SCREEN	Assists user in performing the instrument touch screen calibration	Transfer to another screen
SHUT DOWN SYSTEM	Shuts down the instrument in an orderly fashion which reduces boot time for the next power on.	Transfer to another screen
SENSORS: CALIBRATE HELIUM	SENSOR SAMPLE INTERVAL:	Data entry: <value> min
	MEASURE SENSOR VOLTAGE	Performs a function: <value> V
	SENSOR ACTIVE LENGTH:	Data entry: <value> cm
	CONTIN. MEASURE TIME LIMIT:	Data entry: <value> min
	DIRTY SENSOR MODE:	Toggles between: DISABLED, ENABLED)

**EDITING A FIELD**

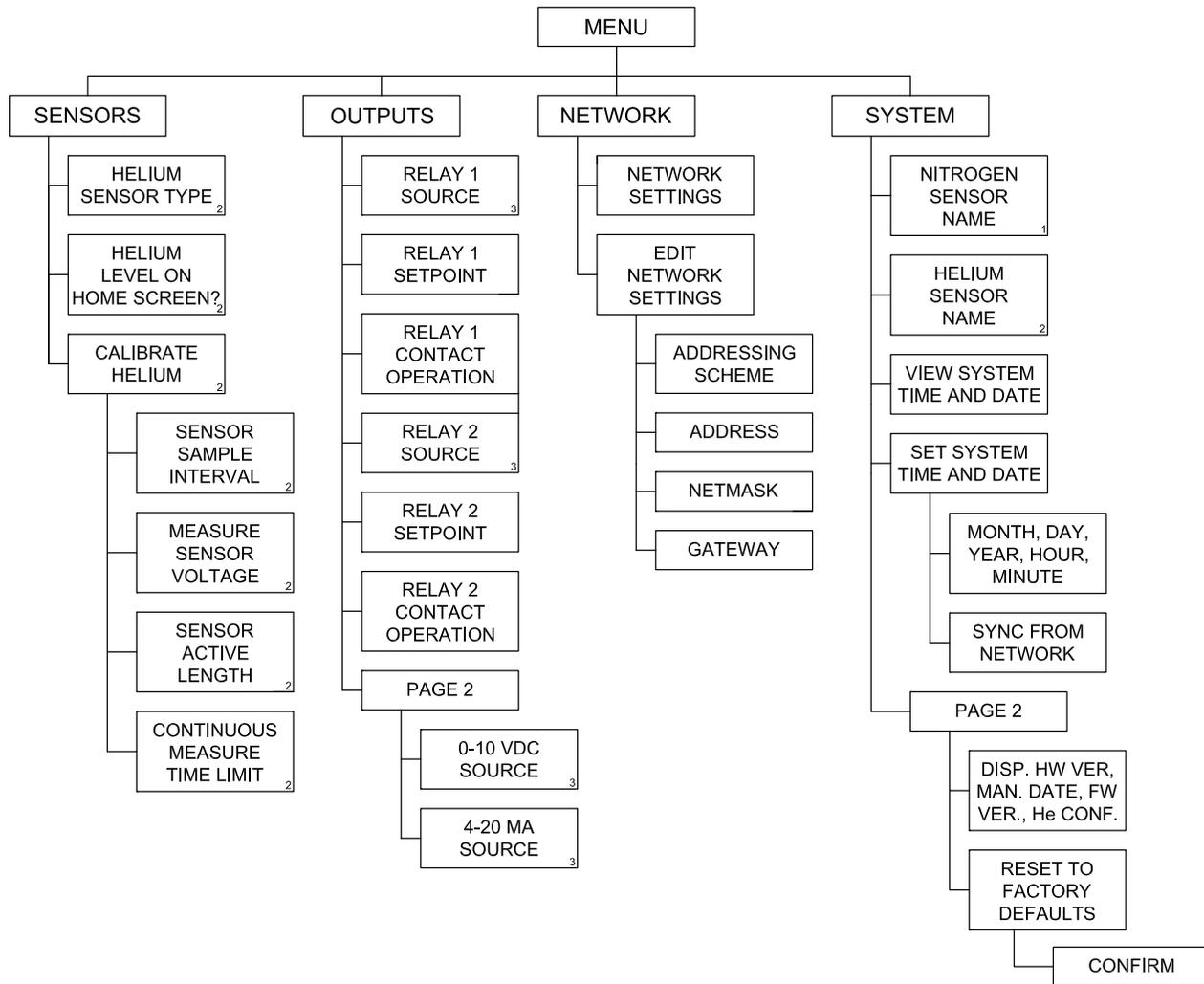
Once a field on a screen has been selected for editing, the footer changes to appear as follows:



**Model 1700 Instrument Footer during editing a field**

Button No.	Name	Function	Reference Paragraph
①	<b>SAVE</b>	Saves the entries made on the screen. The footer changes to the footer shown in Table , above.	
②	<b>CANCEL</b>	Exits out of the screen, not saving entries. The footer changes to the footer shown in Table , above.	
③	<b>ALARM</b> Status	Refer to Table , above.	
④	<b>AUTOFILL</b> Status		

**MENU NAVIGATION**



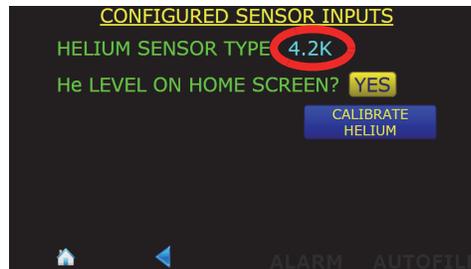
**Model 1700 Menu Structure**

## SUPERCONDUCTING (LIQUID HELIUM) LEVEL

### CONFIGURE THE INSTRUMENT TO DISPLAY HELIUM LEVEL

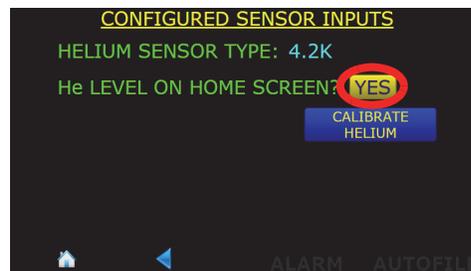
**NOTE** If the instrument was purchased with an AMI LHe level sensor, Steps 1 through 4, below have already been performed.

1. From the main screen, choose the following: MENU > SENSORS.
2. Choose the type of LHe level sensor, 4.2K or 2K.



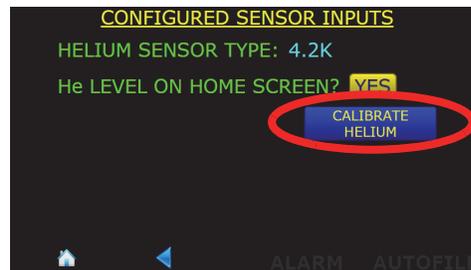
Type of LHe Level Sensor

3. Ensure that He LEVEL ON HOME SCREEN? is set to YES.



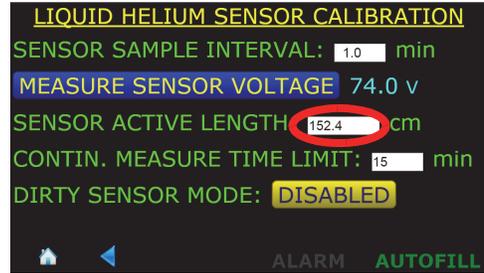
Helium Level On Home Screen

4. Press the **CALIBRATE HELIUM** button.



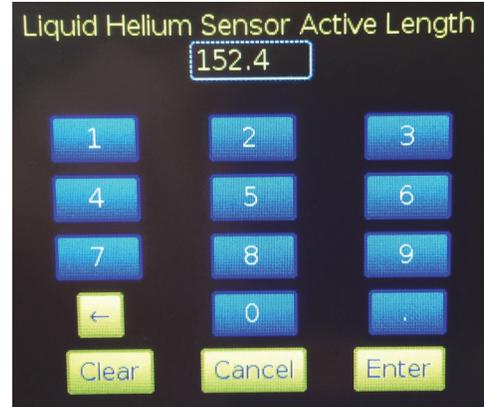
Helium Level On Home Screen

5. Press the **SENSOR ACTIVE LENGTH** field.



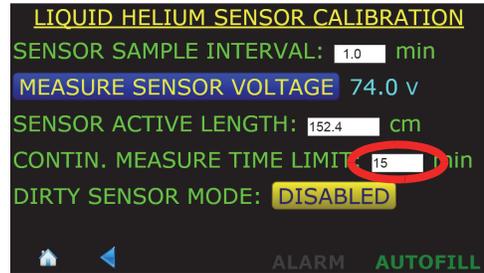
Calibrate Helium Screen

6. In the numeric pop-up keypad, enter the sensor active length in centimeters. Press Enter when finished.



Numeric Keypad

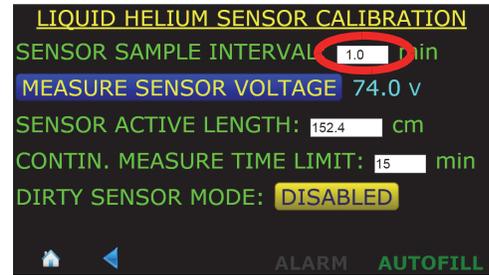
7. Press in the **CONTIN. MEASURE TIME LIMIT** field.
8. Using the pop-up numeric keypad, enter the maximum amount of time that the sensor should remain energized in the **MEASURE CONTINUOUSLY** mode before automatically changing to the **SAMPLE AND HOLD** mode. This limit prevents inadvertent sensor energization for long periods of time which will cause excessive liquid helium boil off. When the sensor is energized (**MEASURE CONTINUOUSLY**) a timer is started and after the **CONTIN. MEASURE TIME LIMIT** is reached, the sensor is de-energized (switches back to **SAMPLE AND HOLD** mode).



Calibrate Helium Screen

**NOTE** Setting the CONTINuous MEASURE TIME LIMIT to 0 (zero) disables the function.

- Set the **SENSOR SAMPLE INTERVAL** to an appropriate value. This value is used by the **SAMPLE AND HOLD** timer to determine how often the reading is updated. The timer is started when the instrument is powered up or when this value is changed.



Setting the Sample Interval

**NOTE** Setting the **SAMPLE INTERVAL** to 0 (zero) disables the **SAMPLE AND HOLD** function.

- Press the Home icon in the screen footer.

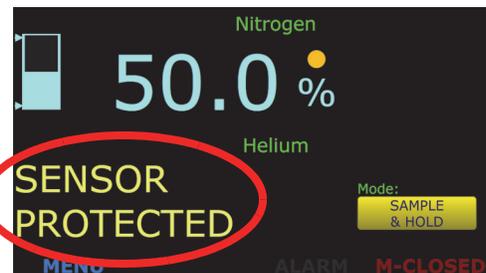
### SENSOR BURNOUT PROTECTION

Operating the sensor in a vacuum without contact with liquid helium can cause thermal damage and/or destruction of the superconducting filament. The Model 1700 is equipped with circuitry that automatically prevents this type of damage from occurring, if the instrument's **LENGTH** setting is properly set to the active length of the connected sensor. If excessive sensor resistance is detected, the Model 1700 display will indicate burnout protection is in effect and the sensor current will be turned off for a minimum of six seconds after which time the instrument will attempt to resume normal operation. When the sensor resistance has returned to approximately the expected value, normal operation will be restored. No relay or alarm states are affected.



Helium Level Sensor Protection Mode

If an attached sensor is not actually installed in a cooled cryostat, then the sensor burnout protection will activate as soon as the Model 1700 is energized and a liquid helium level reading is attempted. This should be considered normal until the sensor is cooled in the helium environment.



Helium Level Sensor Protection Mode

**SAMPLE AND HOLD OPERATION**

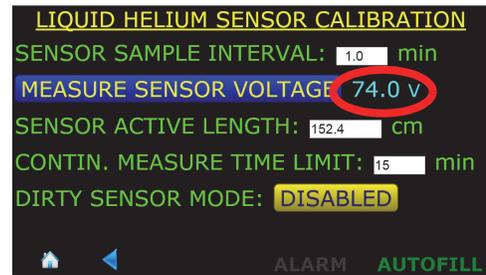
While viewing the home screen, toggle between **SAMPLE AND HOLD** and **MEASURE CONTINUALLY** modes by pressing the button.



**Helium Level Measurement Mode**

**OTHER LIQUID HELIUM FUNCTIONS**

The instrument displays the LHe level sensor voltage. If the voltage is shown in light blue, it is the actual (real-time) voltage as the instrument is in **MEASURE CONTINUALLY** mode. If it is displayed in gray, it is the voltage measured the last time the sensor was energized (**SAMPLE AND HOLD** mode). To update the reading, press the **MEASURE SENSOR VOLTAGE** button and the level reading will be updated as will the displayed sensor voltage.



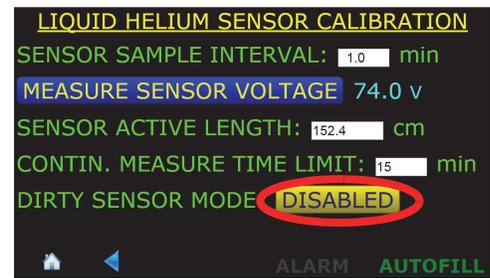
**Helium Sensor Voltage**

AMI expects the helium level sensor to be reasonably clean and free from oil, water, ice, etc. for proper operation. However, it is recognized that some experiments might result in some material being deposited on the sensor wire. Ice formation at some point on the sensor is a typical occurrence. Therefore, the Model 1700 has the capability of increasing the current for a short period of time at the beginning of the measurement cycle (in the SAMPLE mode only) to try and drive the resistive zone of the sensor wire past the dirty region. This operation may or may not be successful depending on the degree of sensor contamination. This mode should be viewed as a stopgap measure only. If correct readings cannot be reestablished, the only choice is to warm the sensor or remove for cleaning or replacement.

**NOTE** Operation in the dirty sensor mode increases liquid helium losses. Consequently, operation in this mode should not be used unless the sensor is known or anticipated to become dirty or the helium level measurement is in question due to unclean operation.

To enable the **DIRTY SENSOR MODE**, Press the **DISABLED** button until **ENABLED** appears and press **SAVE**.

Press the home icon in the footer to return to the home screen.



Dirty Sensor Mode

---

## ALARMS AND RELAYS

---

The Model 1700 Instrument has two types of alarms, level-based and time-based alarms.

---

### LEVEL-BASED ALARMS

The Model 1700 Instrument has two user-configurable level alarms. Each alarm can be triggered by either level measurement (for dual level configured instruments). Each alarm can be configured to be active above or below a user-defined setpoint.

When an alarm condition occurs, an audible alert will sound and visual indication on the front panel.

Alarm №1 and №2 have relays associated with them. These relays have Normally Open (NO) contacts. The alarm/relays can be assigned to either the helium or nitrogen channel and the alarm/relay can each be configured to have the alarm active when the reading is either  $\leq$  or  $\geq$  the setpoint. As an example of this setup flexibility, a level channel can be configured to have an alarm condition when the level is outside a normal operating band.

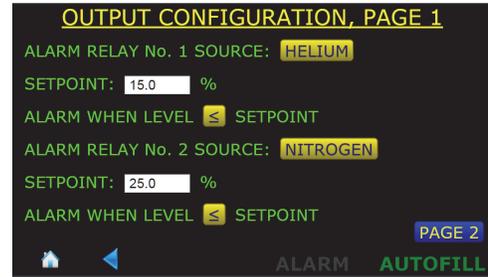
---

### MULTIPLE ALARMS

More than one alarm condition can occur at the same time. The footer will display the cause(s) of the alarm condition(s).

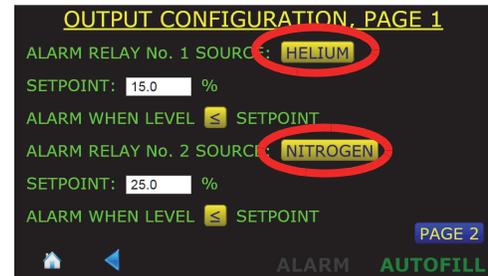
## CONFIGURING ALARM SETPOINTS

1. From the MENU choice, select OUTPUTS and the first page of the Output Configuration screen will be displayed.



Output Configuration Screen, Page 1

2. Ensure the Alarm Relay Source fields are set to **HELIUM** (or **DISABLED**).



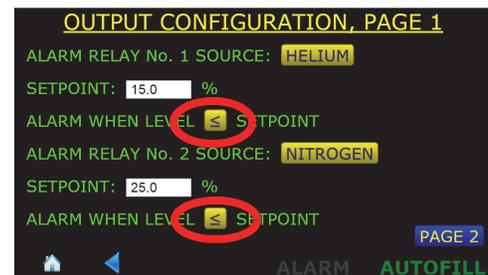
Relay Source Configuration

3. Set the levels at which the alarm will be triggered in the Setpoint fields.



Relay Setpoints

4. Use the ≤ or ≥ button to toggle between the two states of alarm, either alarm when the indicated level is less than or equal to the setpoint or alarm when the indicated level is greater than or equal to the alarm setpoint.



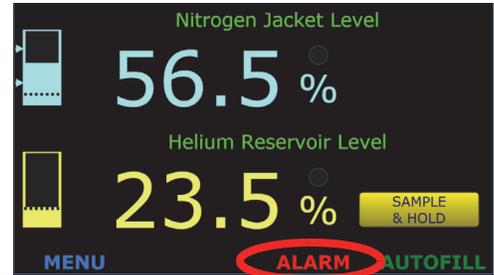
Alarm Condition Above or Below Setpoints

## ACKNOWLEDGING AN ALARM

**NOTE** The alarms are not “latched” so if the alarm condition clears itself, the instrument will remove the alarm condition.

1. When an alarm is initiated, several things will occur:

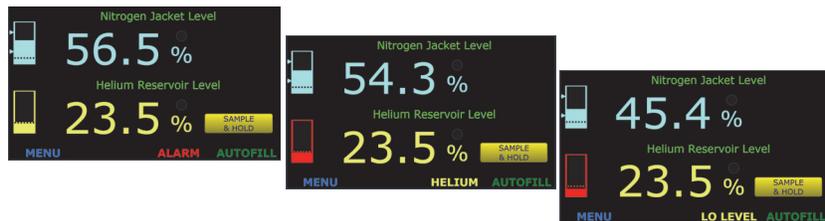
- a. The bar-graph level display that is causing the alarm condition as well as the sensor name will flash red.
- b. The ALARM button in the footer will indicate what the alarm condition is, either by showing LO LEVEL, HI LEVEL, or TIMEOUT.



Alarm Annunciator

- c. An audible alarm will be energized.

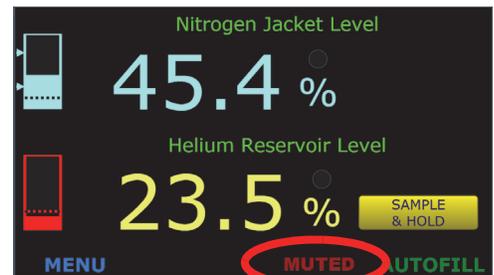
- 2. For example, a helium low level alarm will flash the following three displays in a repeating fashion:



LO LEVEL Alarm Condition Footer Displays

### MUTING AN ALARM

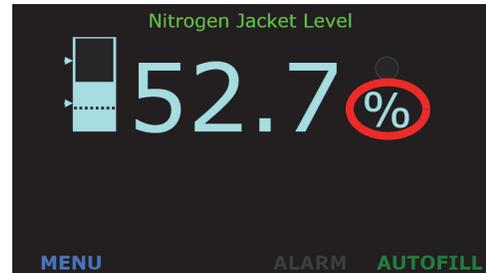
The audible alarm can be muted by pressing the **ALARM** button in the footer. As long as the alarm condition occurs with muting enabled, the **ALARM** button in the footer will alternate between the alarm conditions (Figure ) and **MUTED**.



Muted Alarm Condition

## SELECT THE APPROPRIATE UNITS ON THE DISPLAY

Touch the units on the display to change the units. The available units are percent (%), inches (in), and centimeters (cm).



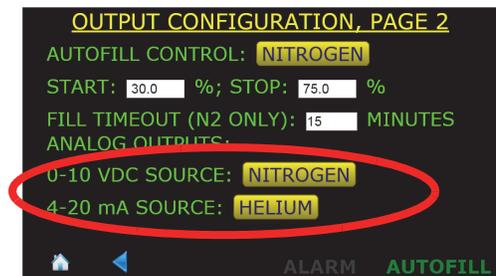
LN<sub>2</sub> Home Screen

## ANALOG OUTPUT SIGNALS

Refer to “Aux I/O Connector” on page 66 of the Appendix for a connector pin-out.

### CONFIGURING THE ANALOG OUTPUTS

1. From the **MENU** screen, choose **OUTPUTS**, then **Page 2**.
2. If necessary, choose the source for the **0-10 VDC** output and **4-20 mA** output.
3. Press the **SAVE** button to save the choice (or **CANCEL** to quit without making a change).
4. Press the home icon to go back to the home screen.

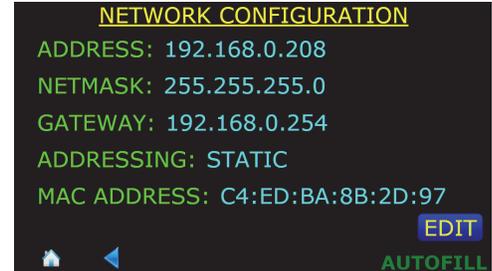


Analog Outputs Source Selection

## ETHERNET CONNECTIVITY

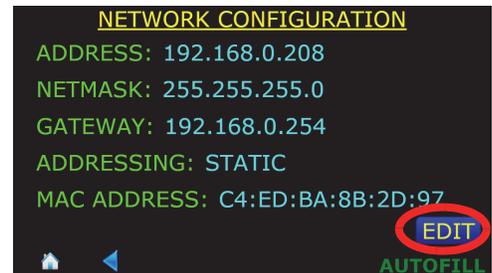
### IP ADDRESSING SCHEME

1. From the **MENU** screen, choose **NETWORK**. The current settings will be displayed.



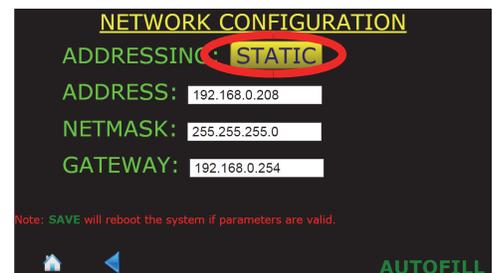
Network Selection

2. To change the settings, choose **EDIT**.



Editing Network Selection

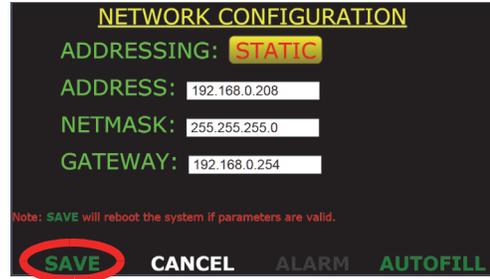
3. In the **ADDRESSING:** button, choose **STATIC**, **DYNAMIC**, or **DISABLED** as appropriate.



Editing Network Settings

4. If **STATIC** is chosen for the addressing scheme, enter **IP ADDRESS**, **NETMASK**, and **GATEWAY** addresses that are appropriate for the connected network. Once an address field is touched, the pop-up keyboard will be presented for data entry. Press **SAVE** when done.
5. If the **DYNAMIC** addressing scheme is chosen, the **IP ADDRESS**, **NETMASK**, and **GATEWAY** addresses will automatically be assigned from a network DHCP server. Press **SAVE** when done.
6. If changes are made, select the **SAVE** button and then the instrument will reboot and reconfigure itself with the chosen settings.

**NOTE** IP Addressing changes are not applied until the instrument is rebooted.



Saving Network Settings

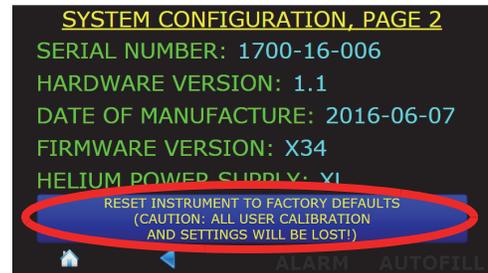
## ABNORMAL OPERATION

### DIRTY HELIUM SENSOR OPERATIONAL MODE

Refer to "Other Liquid Helium Functions" on page 24.

### RESETTING THE INSTRUMENT TO FACTORY DEFAULTS

1. Press **MENU**, then **SYSTEM**, then **PAGE 2**.
2. Press **RESET INSTRUMENT TO FACTORY DEFAULTS**.



System Menu, Page 2

3. Press **RESET** and the instrument will be reset to factory defaults.

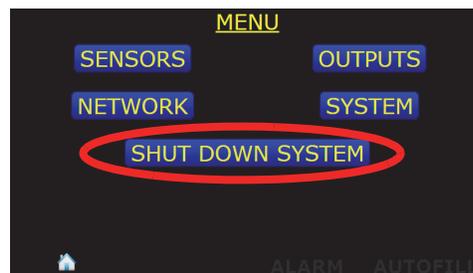


Resetting Instrument to Factory Defaults

## SHUTTING THE INSTRUMENT DOWN

**NOTE** The Model 1700 Instrument is a Linux-based computer system and in order to ensure the file system is properly unmounted, the **SHUT DOWN SYSTEM** function should be invoked. If it is not, i.e. the instrument is shut down by removing power via the front panel power switch, the next time the instrument boots up, it will have to scan the memory system to ensure everything is in order.

1. The instrument should be shut down by using the menu function **SHUT DOWN SYSTEM**.



Invoking Instrument Shut Down

2. Choose **YES** to confirm shut-down.
3. When prompted, turn off the front panel power switch.



Confirming Instrument Shut Down

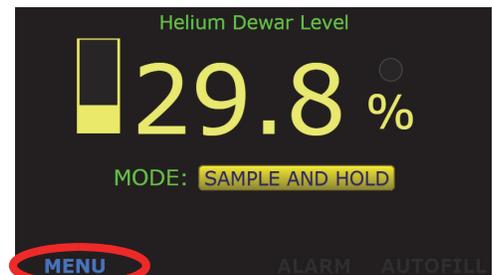


# CALIBRATION

Model 1700 instrument is calibrated at the factory for a specific length sensor(s) for use in a specific liquid(s). The calibration length(s) and calibration liquid(s) are listed on the calibration sticker on the bottom of the instrument.

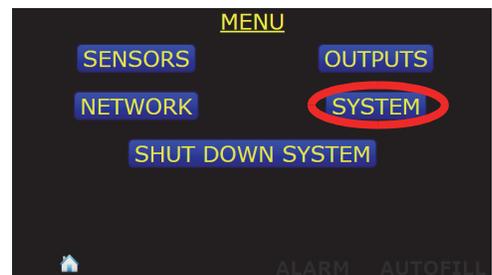
## SETTING THE SYSTEM DATE AND TIME

1. From the home screen, choose **MENU**.



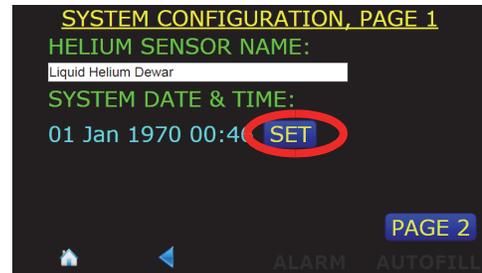
Menu Selection From Home Screen

2. From the **MENU** screen, choose **SYSTEM**.



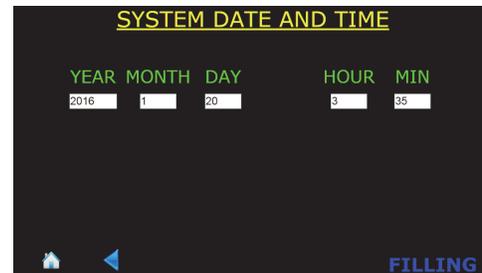
Menu Selection Screen

- From the **SYSTEM CONFIGURATION, PAGE 1** screen, choose **SET**.



System Menu, Page 1

- Edit the **YEAR, MONTH, DAY, HOUR,** and **MIN** fields as necessary. Touching in a field will launch the keyboard on the screen. Edit the information in the field as necessary and choose **Enter** to enter the data in the field and close the pop up keyboard.



System Menu, Page 2

**NOTE** The clock is set to GMT at the factory and is battery backed. There is no provision in the instrument for automatic Daylight Savings Time correction.

- Choose **SAVE** in the footer after all the fields have been edited as necessary.

## SUPERCONDUCTIVITY-BASED (LIQUID HELIUM) LEVEL CALIBRATION

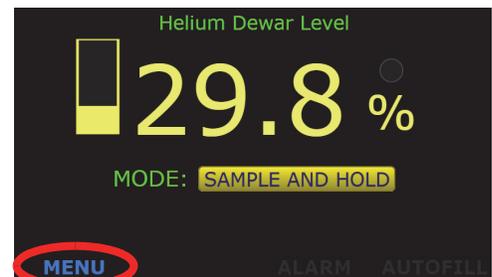
The instrument has been calibrated for Liquid helium Sensors at the AMI facility. No further calibration is needed.

However, to have the Model 1700 Instrument work correctly, at a minimum, the user must enter the correct active length for the sensor.

**NOTE** If the instrument was purchased with a helium level sensor, the active length will be set prior to shipping.

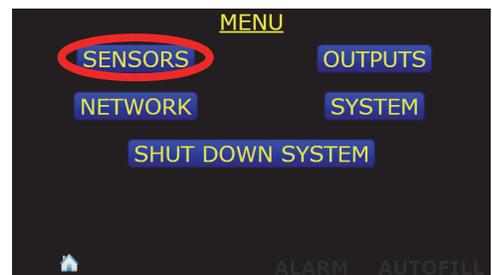
### VERIFY THE LIQUID HELIUM SENSOR TYPE

1. Press the **MENU** button in the lower left corner of the display screen.



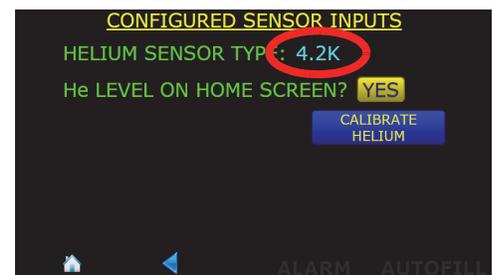
Home Screen for Helium Level Display

2. Choose the **SENSORS** button from the **MENU** screen.



MENU Selection Button

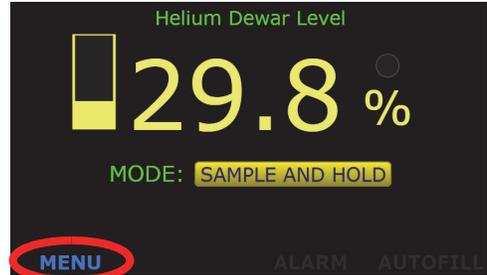
3. Verify that the **HELIUM SENSOR TYPE**: (either **4.2K** or **2K** is correct for the sensor to be used with the instrument. If not, contact the factory for assistance.



SENSORS Selection Button

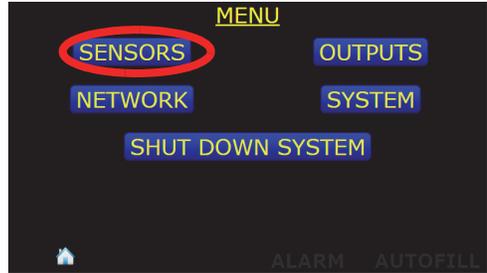
**SENSOR SAMPLE INTERVAL**

1. Press the **MENU** button in the lower left corner of the display screen.



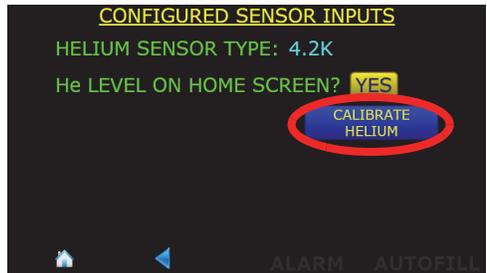
**Home Screen for Helium Level Display**

2. Choose the **SENSORS** button from the **MENU** screen.



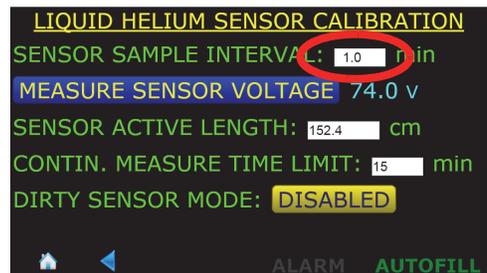
**MENU Selection Button**

3. Choose the **CALIBRATE HELIUM** selection.



**SENSORS Selection Button**

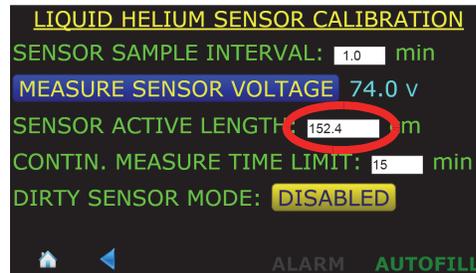
4. Press in the **SENSOR SAMPLE INTERVAL** field. A pop up numeric keypad will be launched.
5. Enter the desired sample interval time in minutes and press **Enter** and then **SAVE**.



**Enter Liquid Helium Sensor Active Length**

### SENSOR ACTIVE LENGTH

1. Press in the **SENSOR ACTIVE LENGTH** field. A pop up numeric keypad will be launched.
2. Enter the **SENSOR ACTIVE LENGTH** in centimeters and press **Enter** and then **SAVE**.

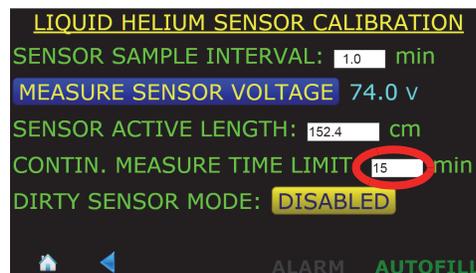


Enter Liquid Helium Sensor Active Length

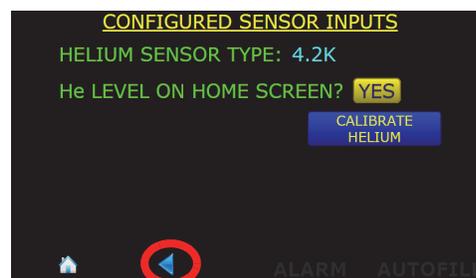
### CONTINUOUS MEASURE TIME LIMIT

The Continuous measure time limit feature sets a maximum time that the instrument will keep the liquid helium level sensor energized. If the instrument is left in the **CONTINUOUS** mode for the **CONTIN. MEASURE TIME LIMIT** interval, the instrument will revert back to the Sample and Hold mode to prevent excessive liquid helium boil off.

1. Press in the **CONTIN. MEASURE TIME LIMIT** field. A pop up numeric keypad will be launched.
2. Enter the maximum time in minutes that the sensor should remain energized in the continuous mode.
3. Press **ENTER** on the keypad and then **SAVE** at the bottom of the screen.
4. Press the back button in the screen footer twice to revert back to the **MENU** screen.



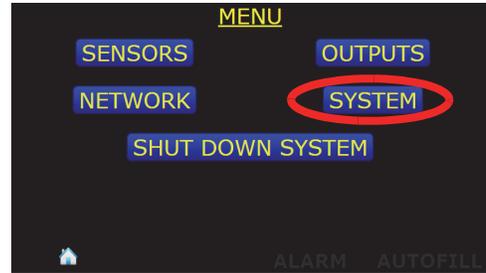
Enter Liquid Helium Sensor Active Length



Footer BACK Button Selection

**SENSOR NAME**

1. Press the **SYSTEM** button.



**SYSTEM Menu Selection**

2. Touch in the **HELIUM SENSOR NAME:** field. The keyboard will be displayed. Edit the displayed name and press **ENTER** and then **SAVE** at the bottom of the screen.



**HELIUM SENSOR NAME: Field**

3. Press the home icon button in the screen footer to return to the level display screen.



**Home Selection Button**

# REMOTE INTERFACE REFERENCE

---

The Model 1700 Instrument provides both serial (RS-232) and Ethernet interfaces as standard features. The serial and Ethernet interfaces can be operated simultaneously. Separate output buffers are provided for the serial and Ethernet return data. The serial and Ethernet interfaces accept both legacy and SCPI syntax for commands and queries.

The Model 1700 provides a web browser connection (port 80) via TCP/IP and presents a mirror of the local display which has hot spots that can be clicked or tapped, and which also accepts keyboard entry for textual and numerical input. The instrument's IP address can be ascertained by referring to the section titled "IP Addressing Scheme" on page 29. By using a web browser to connect to the instrument, all functionality of the Model 1700 can be controlled via the remote connection.

Communication with the Model 1700 via Ethernet or RS-232 (serial) interface can also be accomplished via the interactive mode of a commercially available terminal emulation program, or by socket (port 7180) or COM port programming. When the Model 1700 receives a terminated ASCII string, it always sends back a reply as soon as the string is processed. *When sending commands to the Model 1700, you should wait for the reply from the Model 1700 before sending another command even if the reply consists of only termination characters.*

---

## SCPI COMMAND SUMMARY

---

The following manual conventions are used for SCPI (*Standard Commands for Programmable Instruments*) syntax for the remote interface commands:

- Braces { } enclose valid parameter choices.
- A vertical bar | separates multiple choices for each parameter.

- Triangle brackets < > indicate that you must supply a value.
- Parentheses ( ) within < > indicate alternative units are available.

For example, the command `CONFigure:RELAY1:CHannel {0|1|2}` indicates that the command `CONFigure:RELAY1:CHannel` has three parameter options: 0, 1, or 2, with 0 (disabled) being the default value.

The following section is a reference list of SCPI commands. Refer to the detailed description of each command for information regarding specific parameter choices and their meanings. Capitalized portions of the commands indicate acceptable abbreviations. Default settings are shown in bold.

**NOTE** The commands listed below are the standards-compliant form of the remote interface SCPI language. A set of legacy commands which do not conform to the SCPI standards are also available for backward compatibility with *existing installations* of the Model 13x series (see page 54).

### System-Related Commands

(see page 45 for more information)

\*IDN?

N2?

HE?

SERial\_NUMber?

DATE\_MANUfacture?

HardWare\_VERsion?

FirmWare\_VERsion?

SYStem:BEEPer:IMMediate <seconds>

SYStem:BEEPer:STATe {0|1}

SYStem:KLOCK {0|1}

SYStem:KLOCK?

SYStem:DATE <yyyy>,<mm>,<dd>

SYStem:DATE?

SYStem:TIME <hh>,<mm>,<ss>

SYStem:TIME?

SYStem:REBOOT

SYStem:RESTORE

IPV4ADDR

MACADDR

### Display Configuration Commands and Queries

*(see page 47 for more information)*

DISPLAY:N2?

DISPLAY:HE?

CONFigure:NAME:SENSOr:HE "<string>"

NAME:SENSOr:HE?

### Alarm Configuration Commands and Queries

*(see page 48 for more information)*

CONFigure:RELAY1:CHannel {0|1|2}

RELAY1:CHannel?

CONFigure:RELAY1:SETpoint <level>

RELAY1:SETpoint?

CONFigure:RELAY1:OPeration {0|1}

RELAY1:OPeration?

CONFigure:RELAY2:CHannel {0|1|2}

RELAY2:CHannel?

CONFigure:RELAY2:SETpoint <level>

RELAY2:SETpoint?

CONFigure:RELAY2:OPeration {0|1}

RELAY2:OPeration?

### Measurement Commands and Queries

*(see page 49 for more information)*

MEASure:HE:LEVel?

MEASure:HE:HOLD

MEASure:HE:CONTinuous

MEASure:HE:SAMPle

MEASure:HE:VOLTage?

MEASure:ADC0?

MEASure:ADC1?

MEASure:ADC2?

### Fill Control and Queries

*(see page 50 for more information)*

CONFigure:FILL:CHannel {0|1|2}

FILL:CHannel?

CONFigure:FILL:A <level>

FILL:A?

CONFigure:FILL:B <level>

FILL:B?

### HE Channel Sampling Commands and Queries

*(see page 52 for more information)*

CONFigure:INTerval:SAMPle <minutes>

HE:INTerval?

CONFigure:HE:TIME\_limit <minutes>

HE:TIME\_limit?

LOG\_LHE {0|1}

LOG\_LHE?

HElium\_PowerSupply?

DIRTY\_sen\_mode?

### Assignment Commands and Queries

*(see page 51 for more information)*

CONFigure:SOURCE:REC\_out {0|1|2}

SOURCE:REC\_out?

CONFigure:SOURCE:CURrent\_LOOP {0|1|2}

SOURCE:CURrent\_LOOP?

### HE Channel Calibration Commands and Queries

(see page 52 for more information)

```
CONFigure:HE:LENgth <value>
HE:LENgth?
```

### Remote Units Commands and Queries

(see page 52 for more information)

```
CONFigure:HE:UNIT {0|1|2} or {PERCENT|CM|INCH}
HE:UNIT?
```

---

## RS-232 CONFIGURATION

---

An RS-232 serial communication port is available as a 9-pin D-type connector on the rear panel of the instrument for serial communication function.

The Model 1700 uses the following *fixed* parameters related to the RS-232 interface:

- *Baud Rate*: 115200
- *Parity*: No Parity
- *Data Bits*: 8 Data Bits
- *Number of Start Bits*: 1 bit
- *Number of Stop Bits*: 1 bit
- *Flow Control*: None

---

### SERIAL PORT CONNECTOR AND CABLING

A PC-compatible computer's serial port can be directly connected to the Model 1700 via a standard USB-to-serial cable. Refer to the computer's documentation to determine which ports are available on a computer and the required connector type.

The Model 1700 uses only three wires of the rear-panel DB9 connector: pin 2 (transmit), pin 3 (receive), and pin 7 (common). There are no software or hardware handshaking options. The Model 1700 is classified as a DCE (Data Communication Equipment) device since it transmits data on pin 3 and receives data on pin 2. The instrument to which the Model 1700 is attached must do the opposite, i.e., transmit on pin 2 and receive on pin 3 (the requirements for a DTE, or Data Terminal Equipment device).

---

## COMMAND/RETURN TERMINATION CHARACTERS

All commands are transmitted and received as ASCII values and are case insensitive. The Model 1700 always transmits `<CR><LF>` (i.e. a *carriage return* followed by a *linefeed*) at the end of a transmission. The Model 1700 can accept `<CR>`, `<LF>`, `<CR><LF>`, or `<LF><CR>` as termination characters from an external computer.

---

## ETHERNET CONFIGURATION

---

The Model 1700 provides a 10/100Base-T Ethernet interface as a standard feature. It complies with the IEEE 802.3u 100Base-TX and 802.3 10Base-T standards.

The Model 1700 allows its IP address, subnet mask and gateway IP address to be assigned either statically or dynamically. To make these values static and assign them manually, set IP Address Assignment to Static (see page 29) and then set the values using the Edit parameter list. To enable the values to be dynamically assigned by a network DHCP server, set IP Address Assignment to DHCP.

The system name (also known as *host name* or *computer name*), can be set using remote communications (either Ethernet or RS-232); it cannot be edited using the front panel keypad.

All network parameters (even those assigned by a DHCP server) can be viewed using the Network submenu (see page 29).

---

## ETHERNET CONNECTOR

The Model 1700 uses a standard RJ-45 jack for Ethernet communications. The Ethernet jack pinout is fully documented on page 64 in the *Appendix*.

---

## TERMINATION CHARACTERS

All commands and queries are transmitted and received as ASCII values and are case insensitive. The Model 1700 always transmits `<CR><LF>` (a *carriage return* followed by a *linefeed*) at the end of an Ethernet transmission. The Model 430 can accept `<CR>`, `<LF>`, `<CR><LF>`, or `<LF><CR>` as termination characters from an external computer.

---

## PORT ASSIGNMENT

The Model 1700 accepts remote connections to port 7180. Multiple connections to port 7180 are allowed.

---

## COMMAND REFERENCE

---

All commands sent to the Model 1700 are processed and the Model 1700 responds with a return value (if applicable) and termination. If the command is invalid, the Model 1700 will respond with an error code (see the *Error Codes* section). All return values including error codes are terminated with `<CR><LF>` (i.e. a *carriage return* followed by a *linefeed*). For those commands that do not return a value, the Model 1700 will return the `<CR><LF>` termination only.

The remote units settings are saved in non-volatile memory and are restored at power-up.

The Model 1700 instrument may be configured for reading liquid nitrogen, liquid helium, or both. Some commands will not be applicable if the instrument is not configured for certain level measurement.

---

### SYSTEM RELATED COMMANDS

- \*IDN?

Returns the identification string of the Model 1700. The identification string contains the manufacturer name, model number, serial number, and firmware revision code. Example output:

```
AMERICAN MAGNETICS INC.,MODEL 1700,1700-16-002,2.4.32015
```

- N2?

Returns "0" if the instrument is not configured to read liquid nitrogen level.

- HE?

Returns "0" if the instrument is not configured to read liquid helium level, "1" if the instrument is configured to read 4.2K liquid helium level for sensors of active length  $\leq 40$  inches, "2" if the instrument is configured to read 4.2K liquid helium level for sensors of active length  $\leq 80$  inches, "3" if the instrument is configured to read 2K liquid helium level for sensors of active length  $\leq 40$  inches, or "4" if the instrument is configured to read 2K liquid helium level for sensors of active length  $\leq 80$  inches.

- SERIAL\_NUMBER?

Returns the serial number of the instrument as a string, for example: 1700-16-002.

- DATE\_MANUFACTURE?

Returns the date of manufacture as a string in the form *yyyy-mm-dd*, for example: 2016-11-30.

- HARDWARE\_VERSION?

Returns the hardware version of the instrument.

- FIRMWARE\_VERSION?

Returns the firmware version of the instrument, for example:

2.4.32015.

- SYSTEM:BEEPER:IMMEDIATE *<seconds>*

The receipt of this command with a valid argument causes an audible tone to be generated by the instrument. The duration time parameter is specified in seconds.

- SYSTEM:BEEPER:STATE {0|1}

Enables/disables the beeper. When STATE "0" (OFF) is selected, no instrument condition, except the SYSTEM:BEEPER:IMMEDIATE command, shall cause an audible beep to be emitted. When the instrument restarts, this value is reset to a default of "1" (ON).

- SYSTEM:KLOCK {0|1}

This command locks the local controls of an instrument if set to a value of "1" (ON). This includes all front panel, keyboard, or other local interfaces. The state of the lock defaults to "0" (OFF) when the instrument is restarted.

- SYSTEM:KLOCK?

Returns the state of the instrument local controls lock. A return value of "0" indicates the lock is OFF. A return value of "1" indicates the local interfaces, such as the touch display, of the instrument are locked.

- SYSTEM:DATE *<yyyy>,<mm>,<dd>*

Sets the date per *<yyyy>* as a four-digit number; *<mm>* month with range of 1 to 12 inclusive; *<dd>* day of the month. This command requires escalated rights and therefore is only available via the serial port for which access can be controlled.

- SYSTEM:DATE?

Returns the system date if the form *<yyyy>,<mm>,<dd>*.

- SYStem:TIME <hh>,<mm>,<ss>

This command is used to set the instrument's clock:

- <hh> Range of hours is 0 to 23 inclusive.
- <mm> Range of minutes is 0 to 59 inclusive.
- <ss> Range of seconds is 0 to 60.

The response will consist of the set time with three fields separated by commas: <hh>,<mm>,<ss>. This command requires escalated rights and therefore is only available via the serial port for which access can be controlled.

- SYStem:TIME?

Returns the system time in the form <hh>,<mm>,<ss>.

- SYStem:REBOOT

Reboots the instrument. This command requires escalated rights and therefore is only available via the serial port for which access can be controlled.

- SYStem:RESTORE

Reboots the instrument and sets all parameters back to factory defaults. This command requires escalated rights and therefore is only available via the serial port for which access can be controlled.

- IPV4ADDR

Returns the presently assigned TCP/IP version 4 address in the form:  
xxx.xxx.xxx.xxx

- MACADDR

Returns the MAC address of the network interface.

---

## DISPLAY CONFIGURATION COMMANDS AND QUERIES

- DISPLAY:N2?

Returns a "0" if the instrument is not configured to display liquid nitrogen level on the home screen and a "1" if it is.

- DISPLAY:HE?

Returns a "0" if the instrument is not configured to display liquid helium level on the home screen and a "1" if it is.

- `CONFigure:NAME:SENSor:HE "<string>"`

Sets the displayed name of the helium level sensor.

- `NAME:SENSor:HE?`

Returns the displayed name of the helium level sensor.

---

## ALARM CONFIGURATION COMMANDS AND QUERIES

- `CONFigure:RELAY1:CHannel {0|1|2}`

Assigns relay №1 as disabled (0), or to nitrogen (1) or helium (2).

- `RELAY1:CHannel?`

Returns a "0" if relay №1 is disabled, a "1" if the relay is assigned to the nitrogen channel, and a "2" if the relay is assigned to the helium channel. An error return code is generated if attempting to assign the relay to a non-existent measurement channel in the present instrument configuration.

- `CONFigure:RELAY1:SETpoint <level>`

Configures the relay №1 trip setpoint in the currently assigned channel's units.

- `RELAY1:SETpoint?`

Returns the Relay №1 setpoint in the current units.

- `CONFigure:RELAY1:OPeration {0|1}`

Configures relay №1 such that it closes (alarms) when the level is  $\leq$  the setpoint (0) or  $\geq$  the setpoint (1).

- `RELAY1:OPeration?`

Returns a "0" if relay №1 closes (alarms) when the level is above the setpoint and a "1" if the relay closes (alarms) when the level is below the setpoint. By default, relay №1 is configured as a HI level relay with alarm condition when level is greater than the setpoint.

- `CONFigure:RELAY2:CHannel {0|1|2}`

Assigns relay №2 to disabled (0), or to nitrogen (1) or helium (2). An error return code is generated if attempting to assign the relay to a non-existent measurement channel in the present instrument configuration.

- RELAY2:CHannel?

Returns a “0” if relay №2 is disabled, a “1” if the relay is assigned to the nitrogen channel, and a “2” if the relay is assigned to the helium channel.

- CONFigure:RELAY2:SETpoint <level>

Configures the relay №2 trip setpoint in the currently assigned channel’s units.

- RELAY2:SETpoint?

Returns the Relay №2 setpoint in the current units.

- CONFigure:RELAY2:OPeration {0|1}

Configures relay №2 such that it closes (alarms) when the level is  $\leq$  the setpoint (0) or  $\geq$  the setpoint (1)

- RELAY2:OPeration?

Returns a “0” if relay №2 closes (alarms) when the level is below the setpoint and a “1” if the relay closes (alarms) when the level is above the setpoint. By default, relay №2 is configured as a LO level relay with alarm condition when level is less than the setpoint.

---

## MEASUREMENT COMMANDS AND QUERIES

- MEASure:HE:LEVel?

Returns the liquid helium level in the current units.

- MEASure:HE:HOLD

Changes liquid helium level measurement operation from Continuous to Sample and Hold.

- MEASure:HE:CONTInuous

Changes liquid helium level measurement operation from Sample and Hold to Continuous mode.

- MEASure:HE:SAMPle

Energizes the liquid helium level sensor, makes a reading and returns to Sample and Hold mode.

- MEASure:HE:VOLTage?

Returns the last measured liquid helium level sensor voltage in volts.

- MEASure:ADC0?

Returns the last measured liquid helium level sensor voltage in volts.

- MEASure:ADC1?

Returns the liquid helium sensor power supply voltage in volts.

- MEASure:ADC2?

Returns the liquid helium sensor excitation current in milliamperes.

## FILL CONTROL AND QUERIES

- CONFigure:FILL:CHannel {0|1|2}

Assigns the auto fill control relay to either no channel (disabled) (0), nitrogen (1), or helium (2). An error return code is generated if attempting to assign the relay to a non-existent measurement channel in the present instrument configuration.

- FILL:CHannel?

Returns a "0" if the auto fill relay is disabled, a "1" if the relay is assigned to the nitrogen channel, and a "2" if the relay is assigned to the helium channel.

- CONFigure:FILL:A <level>

Sets the A setpoint (control band upper limit) in the assigned channel's current units. The A setpoint (autofill stop) must be greater than the B setpoint (fill start) and must also be between 0% and 100%.

- FILL:A?

Returns the A setpoint (control band upper limit) in the assigned channel's current units.

- CONFigure:FILL:B <level>

Sets the B setpoint (control band lower limit) in the assigned channel's current units. The B setpoint (autofill start) must be less than the A setpoint (fill stop) and must also be between 0% and 100%.

- FILL:B?

Returns the B setpoint (control band lower limit) in the assigned channel's current units.

---

## HE CHANNEL SAMPLING COMMANDS AND QUERIES

- `CONFigure:INTerval:SAMPlE <minutes>`

Sets the liquid helium sampling interval in minutes.

- `HE:INTerval?`

Returns the sampling interval in minutes if the instrument is configured with a helium channel.

- `CONFigure:HE:TIME_limit <minutes>`

Sets the continuous measurement time limit for liquid helium measurements in minutes, after which time the instrument will return to sampling mode.

- `HE:TIME_limit?`

Returns the continuous measurement time limit in minutes.

- `LOG_LHE {0|1}`

Enables (1) or disables (0) liquid helium level logging.

- `LOG_LHE?`

Returns “0” if the liquid helium level logging is disabled, or “1” if enabled.

- `HElium_PowerSupply?`

Returns the helium power supply configuration of the instrument where “0” is not installed, “1” is standard, and “2” is XL version.

- `DIRTy_sen_mode?`

Returns a “0” if the instrument’s dirty sensor mode is disabled for the helium channel and a “1” if it is enabled.

---

## ASSIGNMENT COMMANDS AND QUERIES

- `CONFigure:SOURCE:REC_out {0|1|2}`

Configures the 0-10 V<sub>DC</sub> Recorder Output source to disabled (0), assigned to the nitrogen channel (1), or the helium channel (2). An error return code is generated if attempting to assign the output to a non-existent measurement channel in the present instrument configuration.

- SOURCE:REC\_out?

Returns a “0” if the 0-10 V<sub>DC</sub> Recorder Output is disabled, a “1” if it is configured for the nitrogen channel, and a “2” if it is configured for the helium channel.

- CONFIGure:SOURCE:CURrent\_LOOP {0|1|2}

Configures the 4-20 mA Current Loop output source to disabled (0), assigned to the nitrogen channel (1), or the helium channel (2). An error return code is generated if attempting to assign the output to a non-existent measurement channel in the present instrument configuration.

- SOURCE:CURrent\_LOOP?

Returns a “0” if the 4-20 mA Current Loop output is disabled, a “1” if it is configured for the nitrogen channel, and a “2” if it is configured for the helium channel.

---

## HE CHANNEL CALIBRATION COMMANDS AND QUERIES

- CONFIGure:HE:LENGth <value>

Configures the liquid helium sensor active length in current units. Returns an error if the current units are percent.

- HE:LENGth?

Returns the configured active length of the liquid helium sensor in current units. Returns an error code if the current units are percent.

---

## REMOTE UNITS COMMANDS AND QUERIES

- CONFIGure:HE:UNIT {0|1|2} or {PERCENT|CM|INCH}

Sets the liquid helium level units of measurement to percent (0 or PERCENT), centimeters (1 or CM), or inches (2 or INCH). The default is PERCENT units.

- HE:UNIT?

Returns the current liquid helium level units in use as either C, I, or %.

## ERROR CODES

The Model 1700 returns specific error codes for invalid commands and/or arguments. If an error condition is returned, the command is not processed and the configuration of the instrument is not modified. The table below provides a list of error codes, their meaning, and any associated limits.

Error Code	Meaning	Valid Range
-1	LO (or relay №2 <sup>a</sup> ) setpoint out of range	$0 \leq \text{LO (or relay №2}^{\text{a}}) \leq \text{LENGTH}$
-2	Fill B setpoint (fill start) out of range	$0 \leq B < A$
-3	Fill A setpoint (fill stop) out of range	$B < A \leq \text{LENGTH}$
-4	HI (or relay №1 <sup>a</sup> ) setpoint out of range	$0 \leq \text{HI (or relay №1}^{\text{a}}) \leq \text{LENGTH}$
-5	Attempted to set or query for LENGTH in PERCENT units mode	
-6	Invalid argument, value out of maximum calibration range	$0 < \text{value} \leq 213.36 \text{ cm (HE)}$
-7	INTERVAL setting out of range	$0 \leq \text{INTERVAL} \leq 600 \text{ min}$
-8	Unrecognized command	
-9	Invalid argument, value was negative or non-numeric	
-11	Command exceeds SCPI input buffer limit	256 characters, including spaces, etc.

a. Applies to dual instrument configuration

---

## LEGACY COMMAND REFERENCE

---

The legacy command set is included for compatibility with existing Model 13x installations. New installations should consider using the modern command set that conforms more closely with the SCPI specification. The modern and legacy command sets can be mixed as desired.

All legacy command or queries sent to the Model 1700 are processed and the Model 1700 responds with a return value (if applicable) and termination. If the command is invalid, the Model 1700 will respond with an error code (see the *Error Codes* section). All return values including error codes are terminated with <CR><LF> (i.e. a *carriage return* followed by a *linefeed*). For those commands that do not return a value, the Model 1700 will return the <CR><LF> termination only.

---

### COMMANDS FOR CONTROLLING THE UNITS OF MEASUREMENT

Command:	CM	Function:	Sets the units of measurement to centimeters	Returns:	<CR><LF>
Command:	INCH	Function:	Sets the units of measurement to inches	Returns:	<CR><LF>
Command:	PERCENT	Function:	Sets the measurement to % of sensor length	Returns:	<CR><LF>
Command:	UNIT	Function:	Returns the current units in use	Returns:	C, I, or % <CR><LF>

The CM command sets the units of measurement to centimeters and the INCH command selects inches. The PERCENT command sets the units of measurement to the percentage of sensor length that is immersed in liquid helium. **The units of measurement selected through the remote interface are controlled independently from the units shown on the front panel display.**

The remote units setting is *automatically* saved in permanent memory and is restored at power-up. The UNIT command returns a one character value (and termination) indicating the current units — C for centimeters, I for inches, or % for percentage.

## COMMANDS FOR CONFIGURING PERMANENT MEMORY

Command:	HI=<value>	Function:	Configures the HI setpoint limit	Returns:	<CR><LF>
Command:	LO=<value>	Function:	Configures the LO setpoint limit	Returns:	<CR><LF>
Command:	A=<value>	Function:	Configures the A setpoint (control band upper limit)	Returns:	<CR><LF>
Command:	B=<value>	Function:	Configures the B setpoint (control band lower limit)	Returns:	<CR><LF>
Command:	INTERVAL=<value>	Function:	Configures the sampling interval in minutes	Returns:	<CR><LF>
Command:	LENGTH=<value>	Function:	Configures the active sensor length	Returns:	<CR><LF>
Command:	SAVE	Function:	None (for backward compatibility only).	Returns:	<CR><LF>

The HI and LO command configure the high and low setpoint limit values, respectively. For example, HI=90.0 would configure the high setpoint limit to 90.0 in whichever units of measurement last selected through the serial interface. The A and B commands configure the upper limit and lower limit of the control band, respectively. The HI, LO, A, and B commands are compatible with the percent units selection.

**NOTE** The HI setting is associated with hardware relay №1. The LO setting is associated with the hardware relay №2. This association is fixed and cannot be changed.

The LENGTH command configures the active sensor length setting in the current units. LENGTH=35.0 would configure the active sensor length to 35.0 units of centimeters or inches.

**NOTE** The LENGTH=<value> command will only function if CM or INCH are currently selected as the units of measurement. The LENGTH command does not configure the Model 1700 if the units of measurement are PERCENT.

The INTERVAL command sets the sampling interval used when the instrument is set for sampling mode operation (as opposed to continuous update). INTERVAL=0.1 sets the sampling interval to 0.1 minutes.

The HI, LO, A, B, INTERVAL, LENGTH, and current remote units settings are automatically saved to permanent memory. Saved settings are then recalled each time the power is turned off and then reapplied to the instrument on subsequent power on.

### QUERYING THE CONFIGURATION

Command:	HI	Function:	Returns the HI setpoint limit in the current units	Returns:	<value> <CR><LF>
Command:	LO	Function:	Returns the LO setpoint limit in the current units	Returns:	<value> <CR><LF>
Command:	A	Function:	Returns the A setpoint limit in the current units	Returns:	<value> <CR><LF>
Command:	B	Function:	Returns the B setpoint limit in the current units	Returns:	<value> <CR><LF>
Command:	INTERVAL	Function:	Returns the sampling interval setting in minutes	Returns:	<value> <CR><LF>
Command:	LENGTH	Function:	Returns the active sensor length in the current units	Returns:	<value> <CR><LF>

The HI, LO, A, B, INTERVAL, and LENGTH queries return the current configuration of the instrument. Each return value is terminated with <CR><LF>.

### RETURNING A LEVEL MEASUREMENT

Command:	LEVEL	Function:	Returns the liquid level in the current units	Returns:	<value> <CR><LF>
----------	-------	-----------	---	----------	---------------------

The LEVEL query returns the liquid helium level in the current units selected through the communication interface.

# SERVICE AND REPAIR

---

---

## CLEANING

---

To prevent electrical shock, disconnect the instrument from AC mains power and disconnect all connected wiring before cleaning. Clean the outside of the instrument using a soft, lint-free, cloth slightly dampened with water.

Do not use detergent or solvents.

Do not attempt internal cleaning.

---

## USER REPLACEABLE PARTS

---

Replacement parts for the instrument are listed in the table below.

AMI Part Number	Description
HG0128	Instrument foot
SA 1045	Single Rack Mount Kit
SA 1046	Dual Rack Mount Kit
EF1700	Fuse, 3 A, 250 Vac, 5x20 mm, fast acting, UL/CSA recognized.
HG0005	Battery, 3V lithium, 20mm x 3.2 mm coin cell; CR2032.

---

## BATTERY REPLACEMENT

---

This section describes the procedure for replacing the battery on the instrument's main circuit board.

**WARNING** This procedure should only be performed by a technician who is familiar with electronic instrumentation and trained in electrical safety and ESD precautions. Always disconnect the power cord and any external wiring before removing the instrument cover.

Always disconnect all inputs, cords, and cables before disassembling the instrument.

---

### TOOLS REQUIRED

- Torx Plus (T.M.) size 10 driver (Wera 028034 or equivalent)
- Torx Plus (T.M.) size 15 driver (Wera 028035 or equivalent)
- Small, flat-blade screw driver (for prying)

---

### PROCEDURE

1. Unplug the instrument from the AC power source.
2. Using the T-15 driver, remove the four 8-32 machine screws on the sides of the instrument cover. Set these screws aside as they will be re-used.
3. Using the T-10 driver, remove the four 6-32 machine screws on the rear of the instrument cover. Set these screws aside as they will be re-used.
4. Lift the instrument cover off of the instrument chassis and set aside.
5. Using the small, flat-blade screwdriver, carefully pry the battery from the holder BH1.
6. Install the new battery into the battery holder BH1.
7. Replace the top cover and secure using the eight machine screws which were removed previously.

---

## FUSE REPLACEMENT

---

This section describes the procedure for replacing the two fuses on the instrument's main circuit board.

**WARNING** This procedure should only be performed by a technician who is familiar with electronic instrumentation and trained in electrical safety and ESD precautions. Always disconnect the power cord and any external wiring before removing the instrument cover.

Always disconnect all inputs, cords, and cables before disassembling the instrument.

---

### TOOLS REQUIRED

- Torx Plus (T.M.) size 10 driver (Wera 028034 or equivalent)
- Torx Plus (T.M.) size 15 driver (Wera 028035 or equivalent)
- Small, flat-blade screw driver (for prying)

---

### PROCEDURE

1. Unplug the instrument from the AC power source.
2. Using the T-15 driver, remove the four 8-32 machine screws on the sides of the instrument cover. Set these screws aside as they will be re-used.
3. Using the T-10 driver, remove the four 6-32 machine screws on the rear of the instrument cover. Set these screws aside as they will be re-used.
4. Lift the instrument cover off of the instrument chassis and set aside.
5. Using the small, flat-blade screwdriver, carefully pry the fuse(s) from the fuse holders F1 and/or F2.
6. Install the new fuse(s) into the fuse holder(s) F1 and/or F2.
7. Replace the top cover and secure using the eight machine screws which were removed previously.

---

## FIRMWARE UPGRADE VIA MICRO-SD CARD REPLACEMENT

---

This section describes the procedure for replacing the Micro SD memory card on the instrument's Single Board Computer (SBC).

**WARNING** This procedure should only be performed by a technician who is familiar with electronic instrumentation and trained in electrical safety and ESD precautions. Always disconnect the power cord and any external wiring before removing the instrument cover.

Always disconnect all inputs, cords, and cables before disassembling the instrument.

---

### TOOLS REQUIRED

- Torx Plus (T.M.) size 10 driver (Wera 028034 or equivalent)
- Torx Plus (T.M.) size 15 driver (Wera 028035 or equivalent)

---

### PROCEDURE

1. Unplug the instrument from the AC power source.
2. Using the T-15 driver, remove the four 8-32 machine screws on the sides of the instrument cover. Set these screws aside as they will be re-used.
3. Using the T-10 driver, remove the four 6-32 machine screws on the rear of the instrument cover. Set these screws aside as they will be re-used.
4. Lift the instrument cover off of the instrument chassis and set aside.



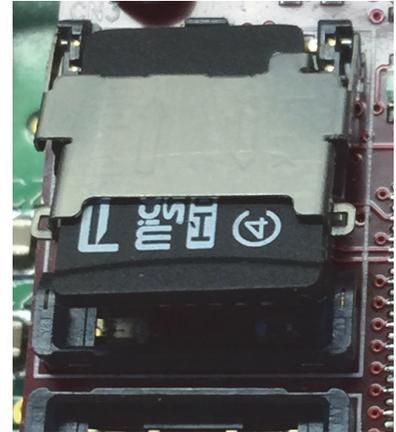
**Instrument With Cover  
Removed**

5. Locate the Micro SD memory card on the SBC.



**Instrument With Cover Removed**

6. Using your thumbnail, press the metal cover that holds the memory card in place to the rear (Unlock).
7. Remove the memory card.
8. Insert the new memory card in the same orientation as the one just removed.
9. Carefully press the metal cover down and slide the cover toward the front of the instrument (Lock).
10. Reinstall the instrument cover.
11. Plug the instrument into the AC power source.
12. Energize the instrument via the front panel power switch.



**Memory Card Released**

The instrument will boot from the new memory card. A re-calibration of the sensor(s) may be necessary.

Note that the firmware version can be determined by looking at the MENU > SYSTEM screen and the FW: field shows the current firmware version.

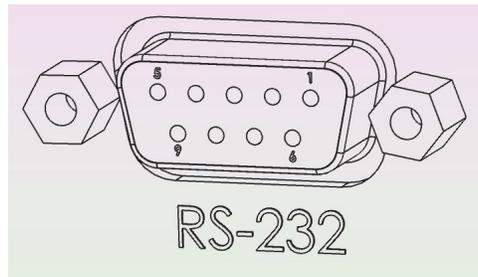


**System Firmware Version**



# APPENDIX

## SERIAL (RS-232) CONNECTOR



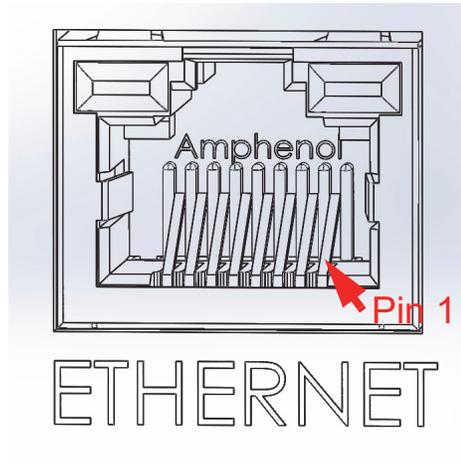
**Serial (RS-232) Pin Out**

The RS-232 connector is a 9-pin D-sub female connector to connect standard DTE 9-pin D-sub male connector using a standard straight (not NULL) cable.

**Serial (RS-232) Pin Definitions**

Pin	Mnemonic	Function
1	N/C	
2	TXD	Transmit Data
3	RXD	Receive Data
4	N/C	
5	GND	Signal Ground
6	N/C	
7	CTS	Clear to Send
8	RTS	Request to Send
9	N/C	

## ETHERNET CONNECTOR

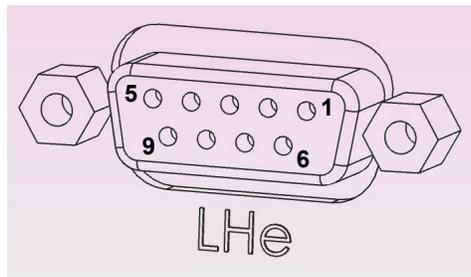


**Ethernet Connector Socket Pin out**

### Ethernet RJ-45 Connector Pin Definitions

Pin	Mnemonic	Function
1	TXD+	Transmit differential output +
2	TXD-	Transmit differential output -
3	RXD+	Transmit differential input +
4	not used	
5		
6	RXD	Transmit differential input -
7	not used	
8		

## LIQUID HELIUM CONNECTOR J1 WIRING



**Liquid Helium (LHe) Level Sensor Connector**

The LHe connector is a 9-pin D-sub female connector.

### LHe Level Connector Pin Definitions

Pin	Function	AMI Standard Wiring Color
1	Sensor I+	Red
2	Not used	
3		
4		
5		
6	Sensor V-	Yellow
7	Sensor I-	Black
8	Sensor V+	Blue
9	Not used	

## AUX I/O CONNECTOR



**Aux I/O Connector**

The AUX I/O connector is a 9-pin D-sub female connector.

### Aux I/O Pin Definitions

Pin	Function	Polarity
1	4-20 mA Current Loop	+
2		-
3	0-10 VDC Output	+
4		-
5	Relay № 1 Dry Contact	N/A
6		
7	Relay № 2 Dry Contact	N/A
8		
9	N/A	

**NOTE** If the Model 1700 is being used to replace a Model 13x instrument, a M-M 9-pin gender changer will be necessary to change the female AUX I/O connector on the Model 1700 to a male type.

---

## DIELECTRIC CONSTANTS FOR CRYOGENIC LIQUIDS

---

### Common Cryogenic Liquid Dielectric Constants<sup>a</sup>

Liquid	Dielectric Constant
Argon (Ar)	1.5034
Carbon Dioxide (CO <sub>2</sub> )	2.5911
Hydrogen (H <sub>2</sub> )	1.2307
Methane (CH <sub>4</sub> )	1.6257
Nitrogen (N <sub>2</sub> )	1.4327
Propane (C <sub>3</sub> H <sub>8</sub> )	1.8029
Oxygen (O <sub>2</sub> )	1.4872

a. NIST RefProp version 9.1

---

## TROUBLESHOOTING

---

The following paragraphs serve as an aid to assist the user in troubleshooting a potential problem with the Model 1700 Instrument. If the user is not comfortable in troubleshooting the system, contact an AMI Technical Support.

If the cause of the problem cannot be located, contact an AMI Technical Support Representative at +1 (865) 482-1056 for assistance. The AMI technical support group may also be reached by internet e-mail at:

**support@americanmagnetics.com**

---

### INSTRUMENT DISPLAYS “LOSS OF SENSOR” CONDITION FOR LHe LEVEL MEASUREMENT

This message indicates that the instrument cannot get sensor excitation current to flow in the sensor circuit<sup>1</sup>. Check that the sensor is wired correctly and that the sensor is connected to the proper connector on the back of the instrument. When the wiring is corrected, place the instrument in MEASURE CONTINUALLY mode and the Loss of Sensor condition should be cleared at which time the instrument can be placed back in SAMPLE & HOLD mode if desired.

---

### INSTRUMENT DISPLAYS “SENSOR PROTECTED” CONDITION FOR LHe MEASUREMENT

This message indicates that the LHe level sensor circuit is of a higher impedance than expected for the selected active sensor length.<sup>2</sup> The protection means that the normal sensor excitation has been stopped and the sensor is intermittently pulsing the current to see if the resistance is back in the expected range. This condition is usually seen when the instrument is set for an active length greater than the level sensor connected to the instrument. See “Sensor Active Length” on page 37. This condition will also occur if a LHe level sensor is energized in a vacuum since the level sensor’s sensing element will heat up to an abnormally high temperature and with its positive temperature coefficient, present a larger than expected resistance to the instrument.

- 
1. The threshold is approximately 1 mA.
  2. The threshold is 5% greater resistance than the SENSOR ACTIVE LENGTH resistance.

---

## FIRMWARE LICENSES

---

The Model 1700 firmware is based on a distribution of Debian Linux, with modifications to the Linux kernel by Technologic Systems and AMI, and additional user interface components by AMI. Some components of this firmware are licensed under agreements that require AMI to make source code available to interested parties. Other components require explicit acknowledgment of the authorship/ownership of the firmware and/or the terms under which it is licensed. In particular:

The Linux kernel version 2.6.34 is licensed under the GNU Public License, version 2. Source code for the version of the Linux kernel used in the Model 1700 is available from the Technologic Systems github repository at <https://github.com/embeddedarm/linux-2.6.34-ts471x.git>

AMI's modifications to that Linux kernel sources are available from: <http://firmware.americanmagnetics.com/1700/kernel-patches.tar>

The Model 1700 uses the "lighttpd" web server, available in source code form from <https://www.lighttpd.net>. It is made available under the following license:

```
Copyright (c) 2004, Jan Kneschke, incremental
All rights reserved.
```

```
Redistribution and use in source and binary forms, with or without
modification, are permitted provided that the following conditions are
met:
```

- Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
- Neither the name of the 'incremental' nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

```
THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS
IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO,
THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR
PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT OWNER OR
CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL,
EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO,
PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR
PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF
LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING
NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS
SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.
```

The Model 1700 firmware includes an OpenSSH client and server and also uses OpenSSH libraries in other components. The individual components of OpenSSH are subject to different licenses, all of which

permit free distribution of compiled versions of the software, though some require explicit notice. Those required notices are reproduced below:

## NO WARRANTY

BECAUSE THE PROGRAM IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MAY MODIFY AND/OR REDISTRIBUTE THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

The 32-bit CRC compensation attack detector in deattack.c was contributed by CORE SDI S.A. under a BSD-style license.

```
* Cryptographic attack detector for ssh - source code
*
* Copyright (c) 1998 CORE SDI S.A., Buenos Aires, Argentina.
*
* All rights reserved. Redistribution and use in source and binary
* forms, with or without modification, are permitted provided that
* this copyright notice is retained.
*
* THIS SOFTWARE IS PROVIDED ``AS IS'' AND ANY EXPRESS OR IMPLIED
* WARRANTIES ARE DISCLAIMED. IN NO EVENT SHALL CORE SDI S.A. BE
* LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY OR
* CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OR MISUSE OF THIS
* SOFTWARE.
*
* Ariel Futoransky <futo@core-sdi.com>
* <http://www.core-sdi.com>
```

ssh-keyscan was contributed by David Mazieres under a BSD-style license.

```
* Copyright 1995, 1996 by David Mazieres <dm@lcs.mit.edu>.
*
* Modification and redistribution in source and binary forms is
* permitted provided that due credit is given to the author and the
* OpenBSD project by leaving this copyright notice intact.
```

The Rijndael implementation by Vincent Rijmen, Antoon Bosselaers and Paulo Barreto is in the public domain and distributed with the following license:

```
* @version 3.0 (December 2000)
*
* Optimised ANSI C code for the Rijndael cipher (now AES)
*
* @author Vincent Rijmen <vincent.rijmen@esat.kuleuven.ac.be>
* @author Antoon Bosselaers <antoon.bosselaers@esat.kuleuven.ac.be>
* @author Paulo Barreto <paulo.barreto@terra.com.br>
```

```

*
* This code is hereby placed in the public domain.
*
* THIS SOFTWARE IS PROVIDED BY THE AUTHORS 'AS IS' AND ANY EXPRESS
* OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED
* WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE
* ARE DISCLAIMED. IN NO EVENT SHALL THE AUTHORS OR CONTRIBUTORS BE
* LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR
* CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF
* SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR
* BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY,
* WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE
* OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE,
* EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

```

One component of the ssh source code is under a 3-clause BSD license, held by the University of California, since we pulled these parts from original Berkeley code.

```

* Copyright (c) 1983, 1990, 1992, 1993, 1995
*   The Regents of the University of California. All rights reserved.
*
* Redistribution and use in source and binary forms, with or without
* modification, are permitted provided that the following conditions
* are met:
* 1. Redistributions of source code must retain the above copyright
*   notice, this list of conditions and the following disclaimer.
* 2. Redistributions in binary form must reproduce the above copyright
*   notice, this list of conditions and the following disclaimer in the
*   documentation and/or other materials provided with the distribution.
* 3. Neither the name of the University nor the names of its contributors
*   may be used to endorse or promote products derived from this software
*   without specific prior written permission.
*
* THIS SOFTWARE IS PROVIDED BY THE REGENTS AND CONTRIBUTORS 'AS IS' AND
* ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE
* IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE
* ARE DISCLAIMED. IN NO EVENT SHALL THE REGENTS OR CONTRIBUTORS BE LIABLE
* FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL
* DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS
* OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION)
* HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT
* LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY
* OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF
* SUCH DAMAGE.

```

Remaining components of the software are provided under a standard 2-term BSD license with the following names as copyright holders:

```

Markus Friedl
Theo de Raadt
Niels Provos
Dug Song
Aaron Campbell
Damien Miller
Kevin Steves
Daniel Kouril
Wesley Griffin
Per Allansson
Nils Nordman
Simon Wilkinson

```

Portable OpenSSH additionally includes code from the following copyright holders, also under the 2-term BSD license:

```

Ben Lindstrom
Tim Rice
Andre Lucas

```

Chris Adams  
 Corinna Vinschen  
 Cray Inc.  
 Denis Parker  
 Gert Doering  
 Jakob Schlyter  
 Jason Downs  
 Juha Yrj?l  
 Michael Stone  
 Networks Associates Technology, Inc.  
 Solar Designer  
 Todd C. Miller  
 Wayne Schroeder  
 William Jones  
 Darren Tucker  
 Sun Microsystems  
 The SCO Group  
 Daniel Walsh  
 Red Hat, Inc  
 Simon Vallet / Genoscope

\* Redistribution and use in source and binary forms, with or without  
 \* modification, are permitted provided that the following conditions  
 \* are met:  
 \* 1. Redistributions of source code must retain the above copyright  
 \* notice, this list of conditions and the following disclaimer.  
 \* 2. Redistributions in binary form must reproduce the above copyright  
 \* notice, this list of conditions and the following disclaimer in the  
 \* documentation and/or other materials provided with the distribution.  
 \*

\* THIS SOFTWARE IS PROVIDED BY THE AUTHOR ``AS IS'' AND ANY EXPRESS OR  
 \* IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES  
 \* OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED.  
 \* IN NO EVENT SHALL THE AUTHOR BE LIABLE FOR ANY DIRECT, INDIRECT,  
 \* INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT  
 \* NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE,  
 \* DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY  
 \* THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT  
 \* (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF  
 \* THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Portable OpenSSH contains the following additional licenses:

a) md5crypt.c, md5crypt.h  
 \* "THE BEER-WARE LICENSE" (Revision 42):  
 \* <phk@login.dknet.dk> wrote this file. As long as you retain this  
 \* notice you can do whatever you want with this stuff. If we meet  
 \* some day, and you think this stuff is worth it, you can buy me a  
 \* beer in return. Poul-Henning Kamp  
 b) snprintf replacement  
 \* Copyright Patrick Powell 1995  
 \* This code is based on code written by Patrick Powell  
 \* (papowell@astart.com) It may be used for any purpose as long as this  
 \* notice remains intact on all source code distributions  
 c) Compatibility code (openbsd-compat)  
 Apart from the previously mentioned licenses, various pieces of  
 code  
 in the openbsd-compat/ subdirectory are licensed as follows:  
 Some code is licensed under a 3-term BSD license, to the following  
 copyright holders:  
 Todd C. Miller  
 Theo de Raadt  
 Damien Miller  
 Eric P. Allman  
 The Regents of the University of California  
 Constantin S. Svintsoff  
 \* Redistribution and use in source and binary forms, with or without

```

* modification, are permitted provided that the following conditions
* are met:
* 1. Redistributions of source code must retain the above copyright
*   notice, this list of conditions and the following disclaimer.
* 2. Redistributions in binary form must reproduce the above copyright
*   notice, this list of conditions and the following disclaimer in the
*   documentation and/or other materials provided with the distribution.
* 3. Neither the name of the University nor the names of its contributors
*   may be used to endorse or promote products derived from this software
*   without specific prior written permission.
*

```

```

* THIS SOFTWARE IS PROVIDED BY THE REGENTS AND CONTRIBUTORS ``AS IS'' AND
* ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE
* IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE
* ARE DISCLAIMED. IN NO EVENT SHALL THE REGENTS OR CONTRIBUTORS BE LIABLE
* FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL
* DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS
* OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION)
* HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT
* LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY
* OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF
* SUCH DAMAGE.

```

Some code is licensed under an ISC-style license, to the following copyright holders:

Internet Software Consortium.  
 Todd C. Miller  
 Reyk Floeter  
 Chad Mynhier

```

* Permission to use, copy, modify, and distribute this software for any
* purpose with or without fee is hereby granted, provided that the above
* copyright notice and this permission notice appear in all copies.
*

```

```

* THE SOFTWARE IS PROVIDED "AS IS" AND TODD C. MILLER DISCLAIMS ALL
* WARRANTIES WITH REGARD TO THIS SOFTWARE INCLUDING ALL IMPLIED WARRANTIES
* OF MERCHANTABILITY AND FITNESS. IN NO EVENT SHALL TODD C. MILLER BE LIABLE
* FOR ANY SPECIAL, DIRECT, INDIRECT, OR CONSEQUENTIAL DAMAGES OR ANY DAMAGES
* WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION
* OF CONTRACT, NEGLIGENCE OR OTHER TORTIOUS ACTION, ARISING OUT OF OR IN
* CONNECTION WITH THE USE OR PERFORMANCE OF THIS SOFTWARE.

```

Some code is licensed under a MIT-style license to the following copyright holders:

Free Software Foundation, Inc.

```

* Permission is hereby granted, free of charge, to any person obtaining a *
* copy of this software and associated documentation files (the *
* "Software"), to deal in the Software without restriction, including *
* without limitation the rights to use, copy, modify, merge, publish, *
* distribute, distribute with modifications, sublicense, and/or sell *
* copies of the Software, and to permit persons to whom the Software is *
* furnished to do so, subject to the following conditions: *
*

```

```

* The above copyright notice and this permission notice shall be included *
* in all copies or substantial portions of the Software. *
*

```

```

* THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS *
* OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF *
* MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. *
* IN NO EVENT SHALL THE ABOVE COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, *
* DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR *
* OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR *
* THE USE OR OTHER DEALINGS IN THE SOFTWARE. *
*

```

```

* Except as contained in this notice, the name(s) of the above copyright *
* holders shall not be used in advertising or otherwise to promote the *
* sale, use or other dealings in this Software without prior written *
* authorization. *

```

```

*****/

```

The Model 1700 firmware uses portions of the "tslib" touchscreen library, which are licensed under the GNU Public License, version 2.

The source code to tslib was obtained by AMI from github.com using the command: `git clone https://github.com/kergoth/tslib`

The Model 1700's touchscreen browser was linked against the Qt libraries for The X Window System that were available from the Debian package repository. The source code for those libraries, as well as the compilers and other tools required to recompile those libraries and the browser, are available from the Debian repository using the normal Debian package manipulation commands, e.g. `pkg-add` or `symantic`. The source code for the browser is brief enough to be included here:

```
---begin file browser.cpp---
#include <QtGui>
#include <QtWebKit>
int main(int argc, char** argv) {
    QApplication app(argc, argv);
    QWebView view;
    view.setWindowFlags (Qt::FramelessWindowHint);
    view.showFullScreen ();
    view.setUrl(QUrl(argv[1]));
    return app.exec();
}
---end file browser.cpp---
---begin file browser.pro---
QT += webkit
SOURCES = browser.cpp
---end file browser.pro---
```

The Model 1700 firmware uses the Jansson library for encoding and decoding messages in the JSON (JavaScript Object Notation) format. The Jansson library is subject to the following license:

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

The "home" icon was obtained from [https://www.iconfinder.com/icons/40798/home\\_icon#size=128](https://www.iconfinder.com/icons/40798/home_icon#size=128)

The license terms stated on that page are: Free for commercial use (Do not redistribute)

The "back" icon was obtained from: [https://www.iconfinder.com/icons/27865/play\\_right\\_arrow\\_icon#size=128](https://www.iconfinder.com/icons/27865/play_right_arrow_icon#size=128)

The license terms stated on that page are: Creative Commons Attribution-No Derivative Works 3.0 Unported

The X.org display server is licensed under the following conditions:

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.



# GLOSSARY

## ABBREVIATIONS AND ACRONYMS

Term	Meaning
AC; ac	Alternating Current; strictly, electrical <i>current</i> that periodically reverses direction. Typically used also to describe an electrical power source in terms of the <i>voltage</i> . For example, 240 VAC.
ASCII	American Standard Code for Information Interchange; numerical representation of characters such as 'a' or '@' or an action (such as line-feed); 'plain' raw text with no formatting such as tabs, bold or underscoring
BNC connector	A miniature quick connect/disconnect RF connector used for coaxial cable, featuring two bayonet lugs on the female connector.
CR	Text Carriage-Return character
Cryogen	A substance for obtaining low temperatures. in the case of use with the Model 1700 instrument, a cryogen is a liquefied gas such as liquid nitrogen or liquid helium.
D-Sub	Term referring to the family of connectors containing an odd number of pins in two parallel rows with a 1-pin difference in pins-per-row (DB9, DB15, and DB25 are most common)
DB9	Type of electrical connector containing 9 pins arranged in two parallel rows of 4 pins and 5 pins each
DCE	Data Circuit-terminating Equipment - a device that sits between the Data Terminal Equipment (DTE) and a data transmission circuit.
DHCP	Dynamic Host Configuration Protocol; a computer networking protocol which dynamically distributes the IP address to networked devices
dt	Rate of change
DTE	Data Terminal Equipment - an end instrument that converts user information into signals or reconverts received signals. A DTE device communicates with the Data Circuit-terminating Equipment (DCE).

Term	Meaning
ECL	Electrical Connection Lubricant - also known as Dielectric Tune-up Grease, a protective lubricant that prevents corrosion.
$E_o$	Power supply output voltage
i, I	Electrical current flow
$I_o$	Power supply output current
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
I/O	Input/Output; The hardware and associated protocol that implement communication between information processing systems and/or devices. Inputs are the signals or data received by the system or device, and outputs are the signals or data sent from it.
IP	Internet Protocol; when used with "address", refers to a numerical Internet address
kG	kilogauss: a magnetic field unit of measurement
LED	Light-Emitting Diode; a semiconductor device that emits light when energized - used for visual status indication
LHe	Liquid Helium
Max	Maximum
Min	Minimum
MSDS	Material Safety Data Sheet - provides workers and emergency personnel with procedures for handling or working with a specific substance in a safe manner and includes information such as physical data, toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill-handling procedures.
$R_{lead}$	Electrical circuit lead or wiring resistance
RS-232	RS-232 is a long-established standard and protocol for relatively low speed serial data communication between computers and related devices; originally established for teletype-writer communication.
SCPI	Standard Commands for Programmable Instruments
V	Volts
VA	Volt-amperes ( $V \times I$ ); a unit of electrical reactive power
$V_{lead}$	Voltage ( $I \times R$ ) developed across circuit lead or wiring resistance due to current flow
$V_m$	Magnet voltage
$V_s$	Power supply voltage

**A**

abbreviations and acronyms 77

analog input  
pin outs 65, 66

**C**

command  
conventions 39  
summary  
system-related commands 40

command summary 39–43

Configuration, instrument ix

connecting  
liquid helium sensors 11

connectors  
RJ-45 - see Ethernet

cryogenic liquids vi

cryogenic liquids, first aid vii

**E**

Ethernet

configuration  
connector 44  
termination characters 44  
remote commands 45  
remote port 7180 44

Ethernet connection pin out 64

**F**

first aid vii

front panel layout 4

**I**

installing

earth ground ix  
liquid helium sensors 10  
mounting 9  
power 13  
unpacking 9

instrument description 1

Instrument part number definition x

IP Address 44, 77

**L**

liquid helium sensor  
connector J1 wiring 65  
connector warning 11

lead wire sizing 11  
sensor preparation  
11

liquid level system terminology 77

**M**

menus 16

**O**

operation warnings viii, 9, 11, 13, 58, 59, 60

**P**

power on/off 15

power supply  
operating characteristics 6

**R**

rear panel layout 5

remote commands

alarm configuration 48  
assignment 51  
display configuration 47  
error codes 53  
fill control 50  
legacy commands 54  
LHe calibration 52  
LHe sampling 51  
measurement 49  
system related 45  
units 52

remote error codes 53

remote interface reference  
command summary 41, 42, 43

remote interface reference - see command

RJ-45 connector - see Ethernet

RS-232

connector pin definitions 64  
pin out 63

RS-232 configuration

parameters 43

**S**

safety

cryogenic liquids vi  
equipment viii  
legend viii  
liquid helium sensor connectors 11  
warnings ix

Safety, cryogenics vi

sensor connector J1 wiring 65, 66

serial communications

- commands 45
- factory reset 47
- interactive communication 39
- set date 46
- set time 47
- system reboot 47
- terminators 44

serial connector pin definitions 64

serial pin out 63

serial port connector/cables 43

system features 1

system specifications 6

## W

Warnings, equipment ix