# MODEL 1700
# LIQUID LEVEL INSTRUMENT

## (LIQUID HELIUM VERSION)

## INSTALLATION, OPERATION, AND MAINTENANCE INSTRUCTIONS

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# 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°F and –452°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 posses 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 austinetic Ni-Cr alloys exhibit good ductility at these low temperatures and the most widely used is 18-8 stainless steel. Copper, Monel®, 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 cryogens 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).

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

I 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.

**Caution**

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 in several ways:

- As a helium level instrument for level sensors with active length up to 40 inches (102 cm) for either 4.2K or 2K LHe.
- 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, pigtailed 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:
LVHe2K = helium for sensors with active length ≤ 40 inches
LVHe4K = helium for sensors with active length ≤ 40 inches
HVHe2K = helium for sensors with active length ≤ 80 inches
HVHe4K = helium for sensors with active length ≤ 80 inches
N = not configured

The sensor active length and length units are appended to the configuration code, ie ...LVKe2K-40IN-...

**E** is used to denote any instrument customization:
S = standard (no customization)
C = instrument modified.

# 1 Introduction

## 1.1 Model 1700 Instrument

The AMI Model 1700 Liquid Level Instrument is a sophisticated measurement and control instrument which provides monitoring liquid helium and/or capacitance-based 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 can be configured for standard (1 - 40") or long sensors (up to 80"). The instrument can be used with either 4.2K or 2K liquid helium level sensors.

### 1.1.1 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 will be configured for either standard active length level sensors (1 - 40 inches) or extra long active length level sensors (1 - 80 inches). The instrument can be used with either 4.2K or 2K level sensor types.

### 1.1.2 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.

### 1.1.3 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.

### 1.1.4 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.

### 1.1.5 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.

### 1.1.6 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.

### 1.1.7 Real Time Clock

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

### 1.1.8 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.

### 1.1.9 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.

### 1.1.10 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

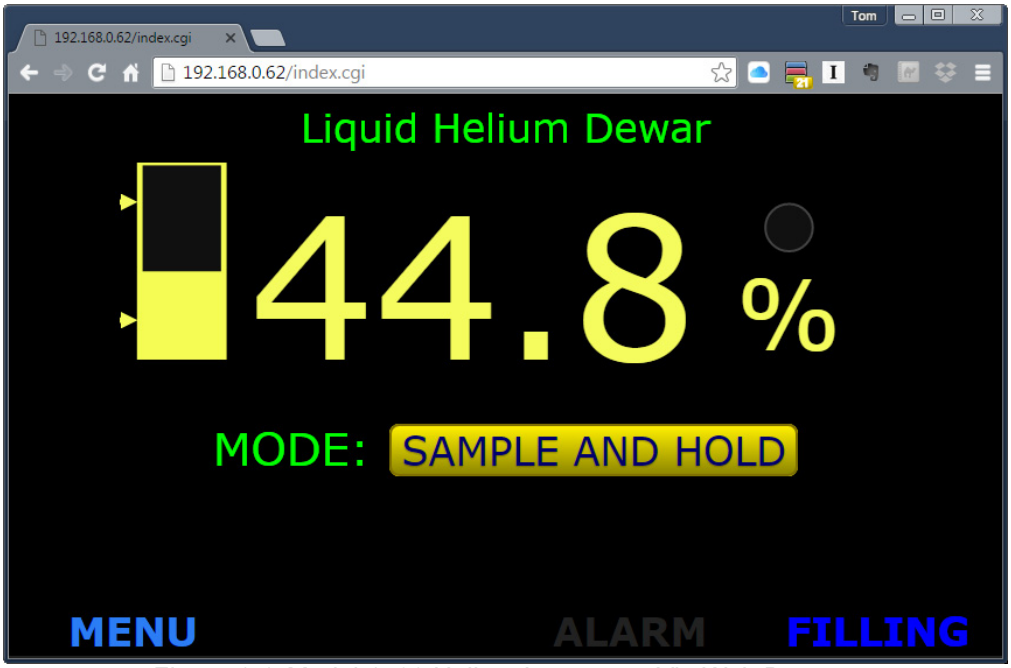


*Figure 1-1.* Model 1700 Helium Instrument Via Web Browser

**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 19.*

## 1.2 Model 1700 Front Panel Layout


*Figure 1-2.* Model 1700 Front View; Dual Channel Instrument Shown

## 1.3 Model 1700 Rear Panel Layout

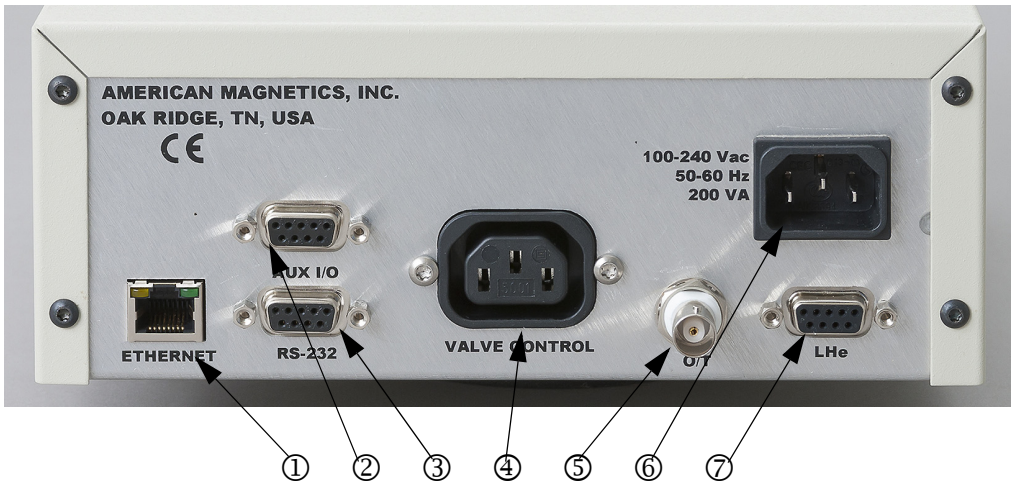


*Table 1-1.* Model 1700 Rear Panel Description

| | |
|---|---|
| **1** | **Computer Network Connector** |
| **2** | **Aux I/O Connector** |
| **3** | **RS-232 Serial Connector** |
| **4** | **Switched Valve Outlet Socket** |
| **5** | **Capacitive Sensor Input Connector** |
| **6** | **Mains Power Entry Connector** |
| **7** | **LHe Level Sensor Connector** |

## 1.4 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) - 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 Sensor Current:** | **4.2K LHe Temperature: 75 $mA_{DC}$ nominal<br>2K LHe Temperature: 57 $mA_{DC}$ nominal** |
| **Dirty Sensor Mode:** | **Approximately twice normal current for 1 second prior to normal measurement excitation** |
| **Superconducting Sensor Voltage:** | **4.2K Sensor: approximately 0.87 $V_{DC}$ per inch of sensor active length @ 10K<br>2K Sensor: approximately 0.66 $V_{DC}$ per inch of sensor active length @ 10K** |
| **Maximum Open Circuit Voltage:** | **48 or 96 $V_{DC}$, 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 $V_{DC}$ and simultaneous 4 - 20 $mA_{DC}$** |
| **4-20 mA Current Loop Power Supply Voltage:** | **12-32 $V_{DC}$** |
| **0-10 $V_{DC}$ Recorder Output Output Load:** | **5k ohms or greater** |
| **Converter Resolution:** | **12 bits** |
| **Integral Non-linearity:** | **±1LSB** |
| **Differential Non-linearity[a]:** | **±1LSB** |
| **Relays** | |

| | |
|---|---|
| **№1 and/or №2 (W171DIP-7, or equivalent):** | **Contact Form: 1 Form A (SPST-NO)<br>Maximum Switched Power: 0.29 W<br>Maximum Switched Current: 3 A<br>Switching Voltage: 60 $V_{AC}$ / 100 $V_{DC}$** |
| **Communication Protocol** | |
| **Host computer network protocol:** | **10Base-T TCP/IP and RS-232 115,200 baud** |
| **IP Addressing:** | **DHCP or static, IPv4** |
| **Network connectivity and traffic indication:** | **Link and Activity LEDs on instrument rear panel** |
| **RS-232 connector specifications:** | **9-pin D-sub female connector to connect standard DTE 9-pin D-sub male connector using a standard straight cable** |
| **Communication command set:** | **SCPI-based. 100% backward compatible with the Model 134, 135, 136 instruments.** |
| **Power Requirements** | |
| **Primary:** | **100-240 ±10% $V_{AC}$, 50-60 Hz, 2.2 A maximum (200 VA plus sum of controller output)** |
| **Backup battery for RTC:** | **CR2032** |
| **Physical** | |
| **Dimensions[b]:** | **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]<br>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]** |
| **Weight:** | **table-top configuration: 3.3 lbm [1.5 kG]; single rack-mount configuration: 4.0 lbm [1.8 kG]** |
| **Environmental Limits** | |
| **Ambient Temperature:** | **Operating: 0°C to 40°C [32°F to 104°F];<br>Non-operating: -20 °C to 60 °C [-4 °F to 140 °F]** |
| **Relative Humidity:** | **0 to 95%; non-condensing** |
| **Maximum Instrument Background Field:** | **Gauss (TBD)** |
| **Standards** | |
| **Test Standards** | **Testing of Equipment for Measurement, Control, and Laboratory Use (IEC 61326-1:2012, EN 61326-1)<br>Electrostatic Discharge (ESD) (EN 61000-4-2)<br>Radiated Immunity (EN 61000-4-3)<br>Fast Transient Burst (EN 61000-4-4)<br>Surges (EN 61000-4-5)<br>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

# 2 Installation

**Warning**

*Equipment warnings apply to all system installation configurations. Refer to "Equipment Warnings" on page xiii, in the Forward to be familiar with the safety requirements for a system installation.*

## 2.1 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.*

## 2.2 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.

## 2.3 Installing the Liquid Helium Level Sensor

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 63). The liquid helium level sensor leads are color coded:

*Table 2-1.* 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 |

## 2.4 Connecting the Sensor to the Instrument

### 2.4.1 Connecting a Liquid Helium Level Sensor

The instrument is connected to the 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 $V_{AC}$ (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.

<table>
<tr><th rowspan="2">Distance</th><th>R=367</th><th>R=315</th><th>R=263</th><th>R=211</th><th>R=107</th><th>R=3.2</th></tr>
<tr><th>L=10”</th><th>L=20”</th><th>L=30”</th><th>L=40”</th><th>L=60”</th><th>L=80”</th></tr>
<tr><td>10 ft.</td><td colspan="4" rowspan="8">36 AWG</td><td rowspan="7">36 AWG</td><td>34 AWG</td></tr>
<tr><td>20 ft.</td><td rowspan="2">30 AWG</td></tr>
<tr><td>30 ft.</td></tr>
<tr><td>40 ft.</td><td>28 AWG</td></tr>
<tr><td>50 ft.</td><td>27 AWG</td></tr>
<tr><td>100 ft.</td><td>24 AWG</td></tr>
<tr><td>200 ft.</td><td>22 AWG</td></tr>
<tr><td>500 ft.</td><td>32 AWG</td><td>16 AWG</td></tr>
</table>

*Table 2-2.* Minimum recommended wire gauge for copper lead wire

## 2.5 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.*

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

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

# 3 Operation

This section describes the operation of the Model 1700 Instrument.

## 3.1 Energizing the Model 1700 Instrument

1. Turn the power switch on the front panel of the instrument to the On ( | ) position. The display will briefly show the AMI logo and then boot information.

   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.*

2. 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[1], refer to the following chapter to calibrate the instrument with an AMI level sensor.

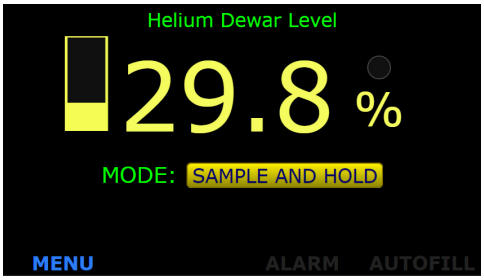


*Figure 3-1.* LHe Home Screen

## 3.2 Screen Navigation

### 3.2.1 Home Screen Footer

Every screen has a footer. The level home screen (refer to Figure 3.2.1 as an example) displays both level information and buttons in the footer to navigate to other screens.

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

The home screen footer appears as follows:


*Figure 3-2.* Home Screen Footer

*Table 3-1.* 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 |

## 3.3 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.


*Figure 3-3.* MENU button on HOME screen

When invoked, the MENU screen will be displayed:

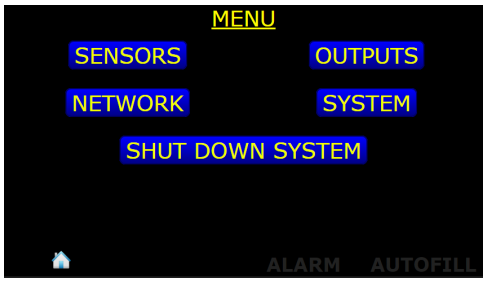


*Figure 3-4.* MENU Selection Screen

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


*Figure 3-5.* 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.


*Figure 3-6.* BACK button

### 3.3.1 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 following Table.

**Note**

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

*Table 3-2.* 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** |

*Table 3-2.* Model 1700 Helium Level Instrument Menu Structure

| Menu Label | Function | Field Type |
|---|---|---|
| **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>** |
| **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** |

*Table 3-2.* Model 1700 Helium Level Instrument Menu Structure

| Menu Label | Function | Field Type |
|---|---|---|
| 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) |

### 3.3.2 Editing a Field

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


*Figure 3-7.* Field Editing Footer

*Table 3-3.* Model 1700 Instrument Footer during editing a field

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

### 3.3.3 Menu Navigation

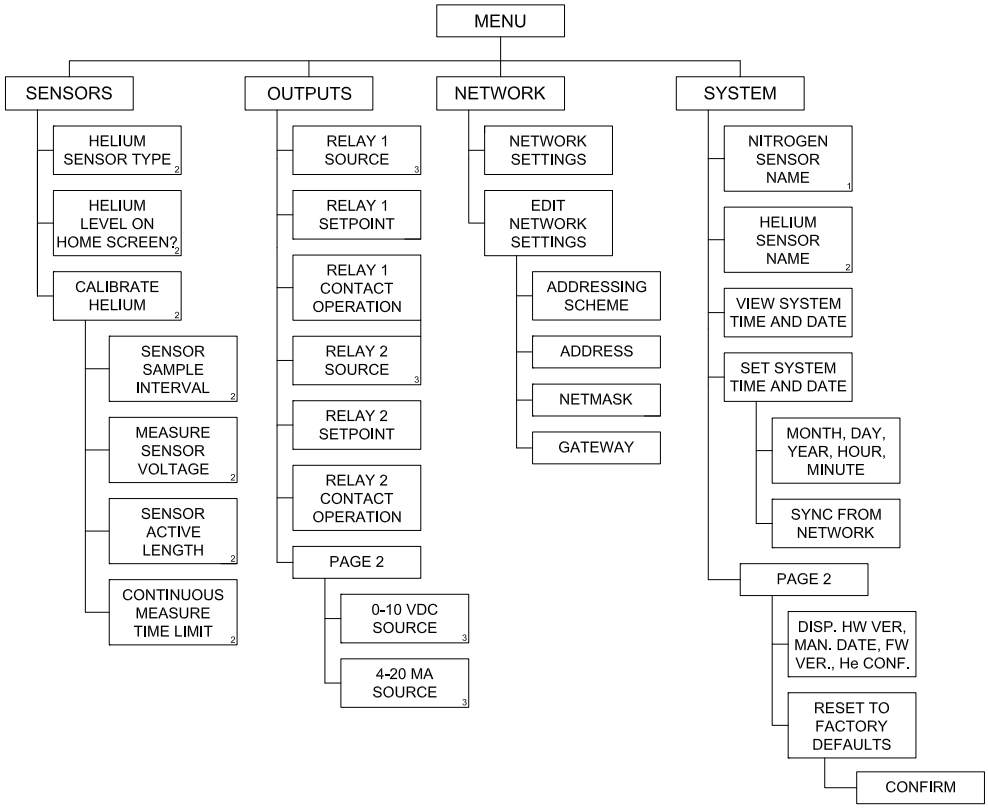


*Figure 3-8.* Model 1700 Menu Structure

## 3.4 Superconducting (Liquid Helium) Level

### 3.4.1 Configure the instrument to display helium level

**Note**

*If the instrument was purchased with an AMI LHe level sensor, Steps 1 through 10, 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.

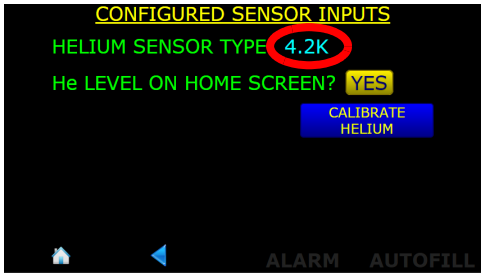


*Figure 3-9.* Type of LHe Level Sensor

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

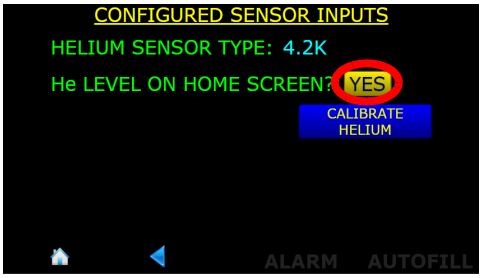


*Figure 3-10.* Helium Level On Home Screen

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

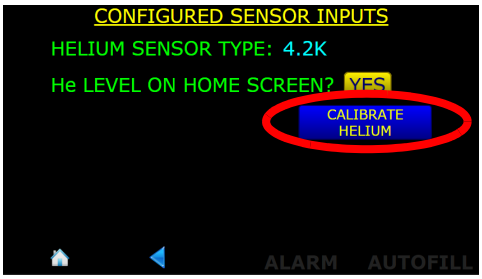


*Figure 3-11.* Helium Level On Home Screen

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

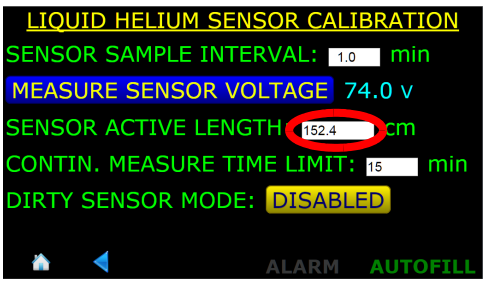


*Figure 3-12.* Calibrate Helium Screen

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

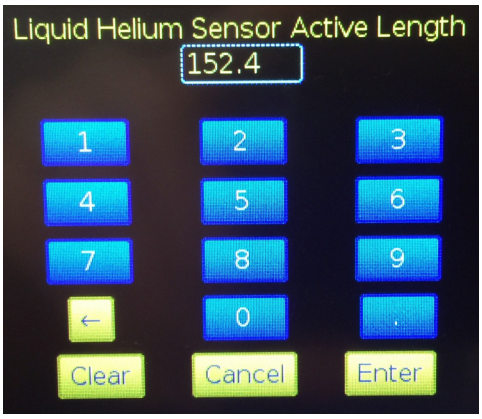


*Figure 3-13.* Numeric Keypad

7. Press in the **CONTIN. MEASURE TIME LIMIT** field.

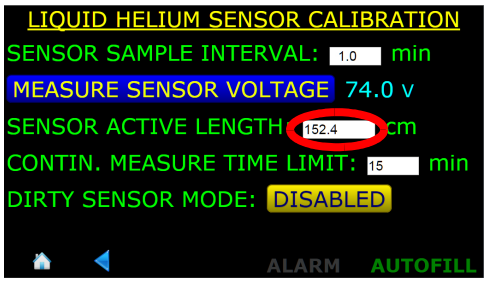


*Figure 3-14.* Calibrate Helium Screen

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 CONTINUOSLY**) 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).

9. 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.

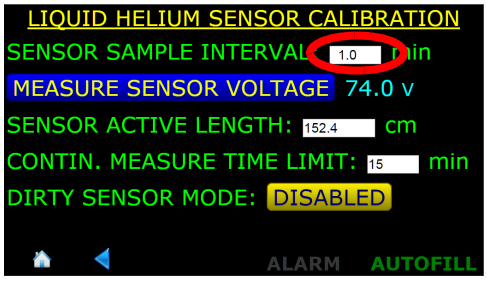


*Figure 3-15.* Setting the Sample Interval

10. Press the Home icon in the screen footer.

### 3.4.2 Sample and Hold Operation

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

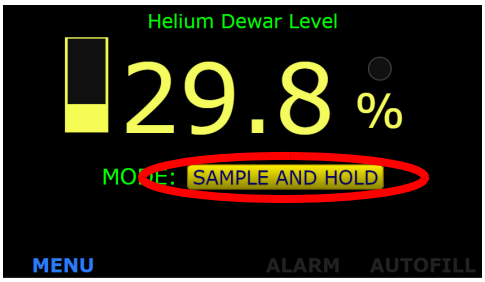


*Figure 3-16.* Helium Level Measurement Mode

### 3.4.3 Other Liquid Helium Functions

### 3.4.4 Other Liquid Helium Functions

1. 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.

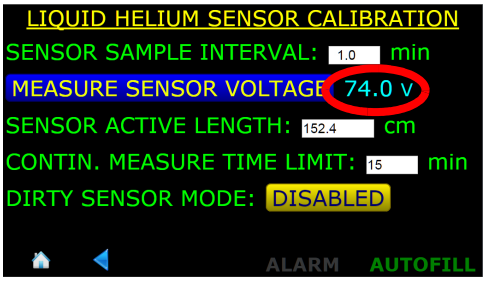


*Figure 3-17.* Helium Sensor Voltage

2. 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 135/136 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**.

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

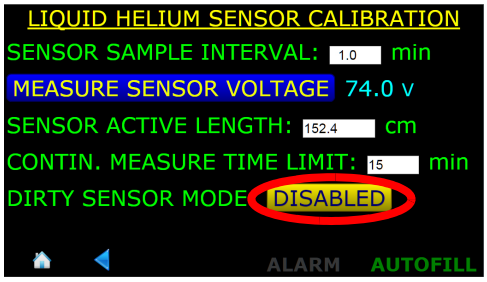


*Figure 3-18.* Dirty Sensor Mode

## 3.5 Alarms and Relays

### 3.5.1 Overview

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

#### 3.5.1.1 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 ≤ or ≥ 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.

#### 3.5.1.2 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).

### 3.5.2 Configuring Alarm Setpoints

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

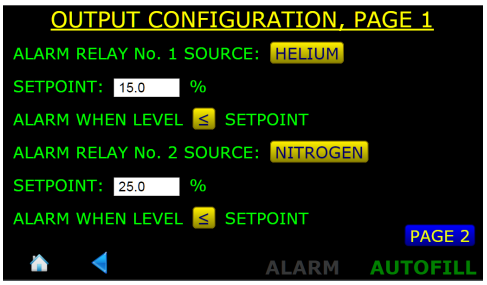


*Figure 3-19.* Output Configuration Screen, Page 1

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

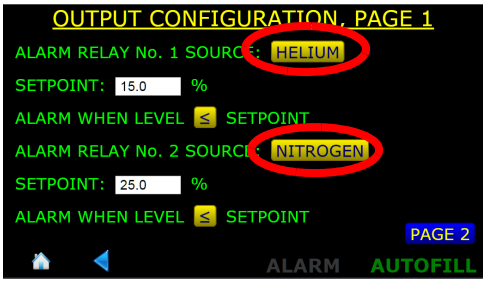


*Figure 3-20.* Relay Source Configuration

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

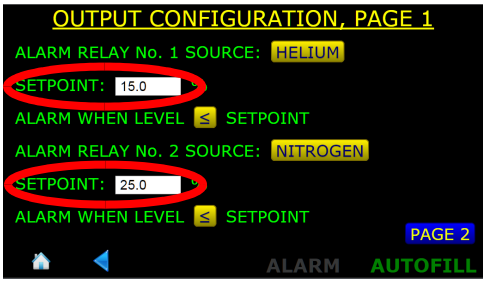


*Figure 3-21.* Relay Setpoints

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.

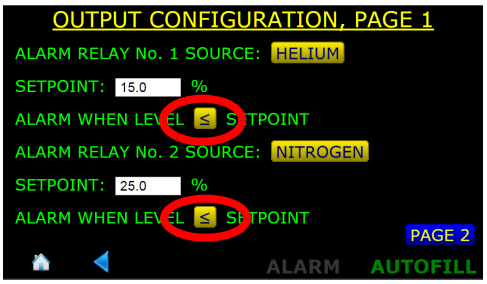


*Figure 3-22.* Alarm Condition Above or Below Setpoints

### 3.5.3 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.

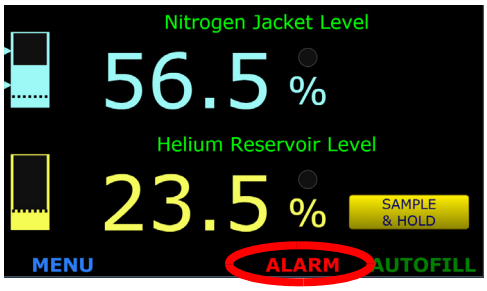


*Figure 3-23.* Alarm Annunciator

   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:

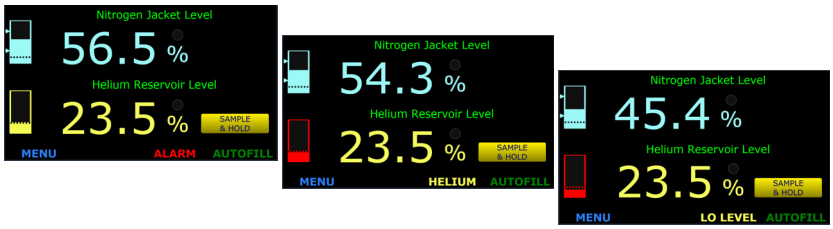


*Figure 3-24.* LO LEVEL Alarm Condition Footer Displays

### 3.5.4 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 3-24) and **MUTED**.

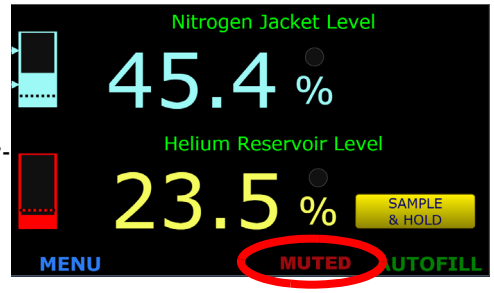


*Figure 3-25.* Muted Alarm Condition

## 3.6 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**).

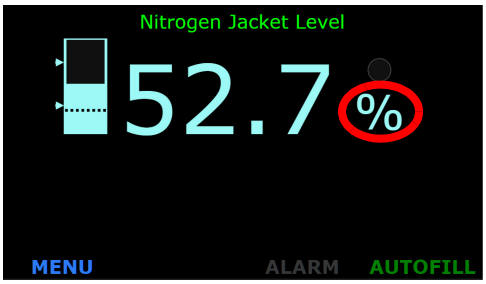


*Figure 3-26.* $LN_2$ Home Screen

## 3.7 Analog output signals

### 3.7.1 Connecting to the Aux Connector

Refer to "Aux I/O Connector" on page 64 of the Appendix for a connector pin-out.

### 3.7.2 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).

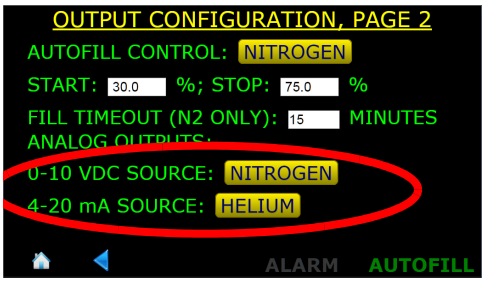


*Figure 3-27.* Analog Outputs Source Selection

4. Press the home icon to go back to the home screen.

## 3.8 Ethernet Connectivity

### 3.8.1 IP Addressing Scheme

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

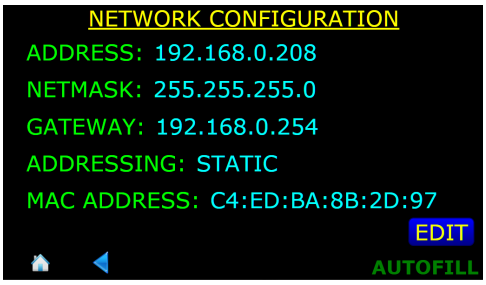


*Figure 3-28.* Network Selection

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

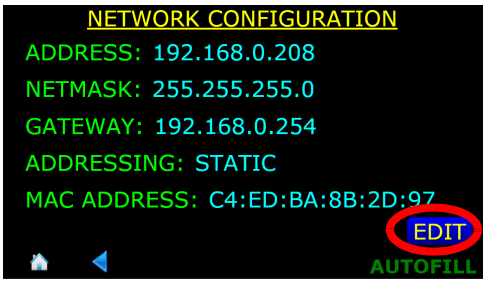


*Figure 3-29.* Editing Network Selection

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

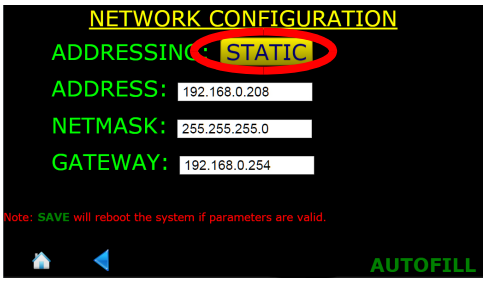


*Figure 3-30.* Editing Network Settings

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**

*Until the instrument is rebooted, the IP Addressing changes will not be applied.*

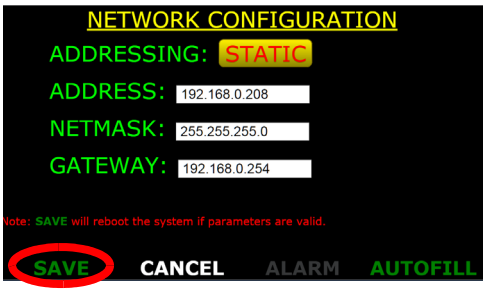


*Figure 3-31.* Saving Network Settings

## 3.9 Abnormal Operation

### 3.9.1 Dirty Helium Sensor Operational Mode

Refer to section 3.4.4 on page 22.

### 3.9.2 Resetting the Instrument to Factory Defaults

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

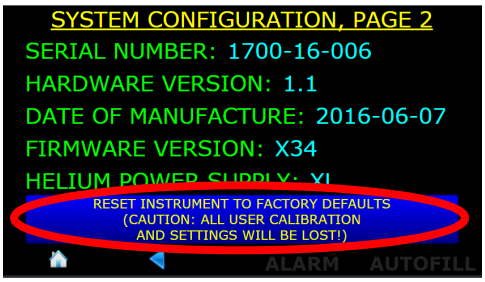


*Figure 3-32.* System Menu, Page 2

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

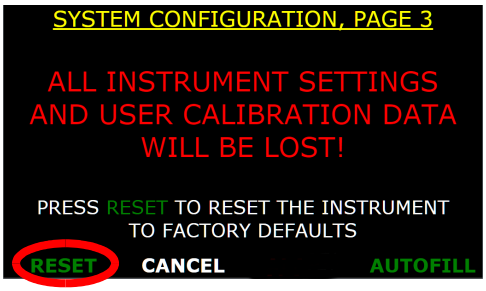


*Figure 3-33.* Resetting Instrument to Factory Defaults

## 3.10 Shutting the Instrument Down

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

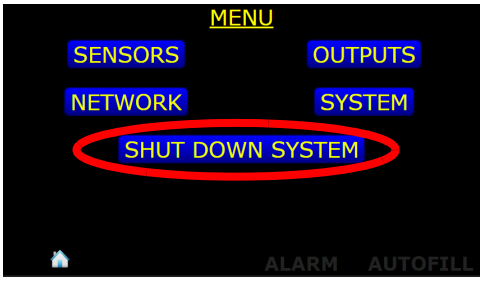


*Figure 3-34.* Invoking Instrument Shut Down

**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 it's memory system to ensure everything is in order.*

2. Choose **YES** to confirm shutdown.

3. When prompted, turn off the front panel power switch.

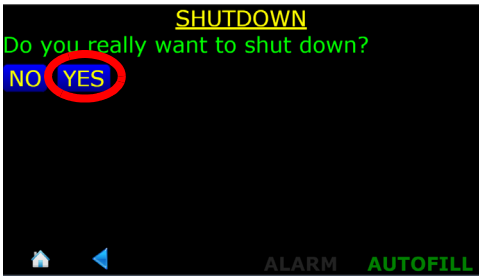


*Figure 3-35.* Confirming Instrument Shut Down

# 4 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.

## 4.1 Setting the System Date and Time

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

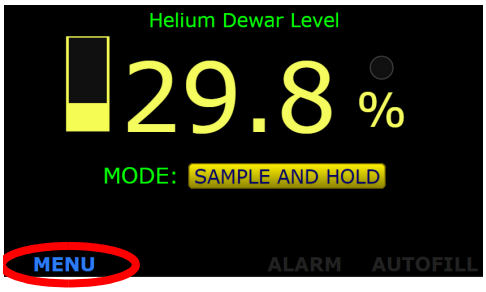


*Figure 4-1.* Menu Selection From Home Screen

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

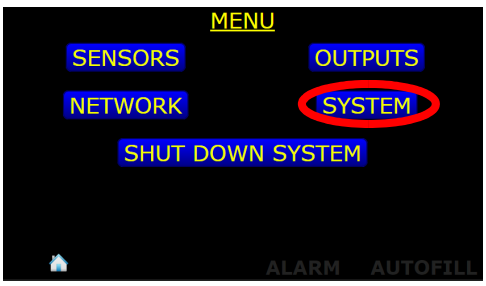


*Figure 4-2.* Menu Selection Screen

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

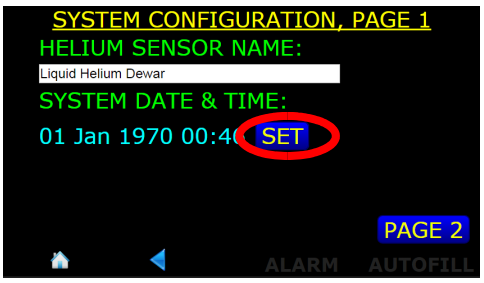


*Figure 4-3.* System Menu, Page 1

4. 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.

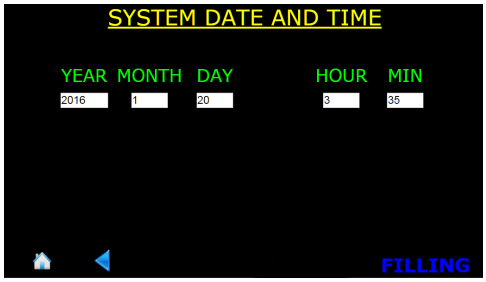


*Figure 4-4.* System Menu, Page 2

**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.

## 4.2 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.*

### 4.2.1 Verify the Liquid Helium Sensor Type

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

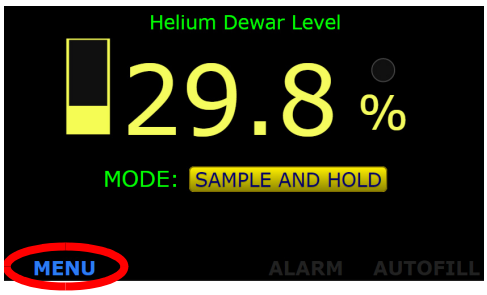


*Figure 4-5.* Home Screen for Helium Level Display

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

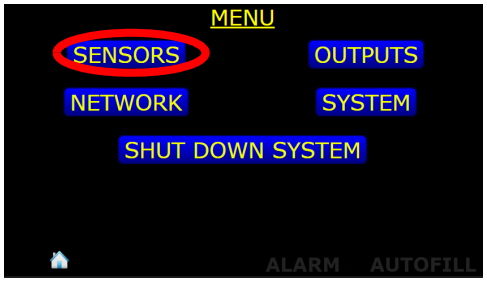


*Figure 4-6.* MENU Selection Button

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.

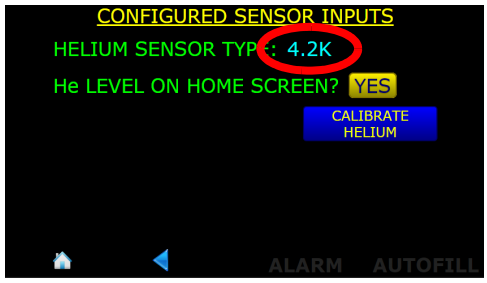


*Figure 4-7.* SENSORS Selection Button

### 4.2.2 Sensor Sample Interval

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

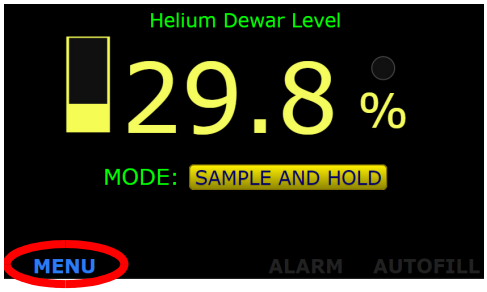


*Figure 4-8.* Home Screen for Helium Level Display

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

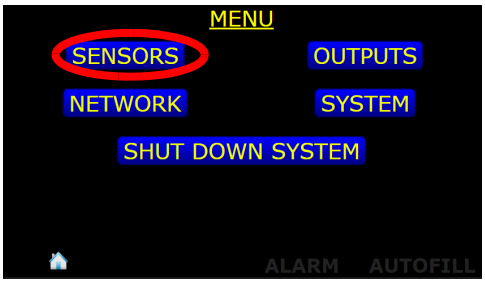


*Figure 4-9.* MENU Selection Button

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

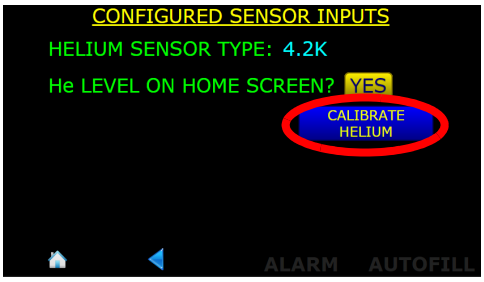


*Figure 4-10.* SENSORS Selection

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**.

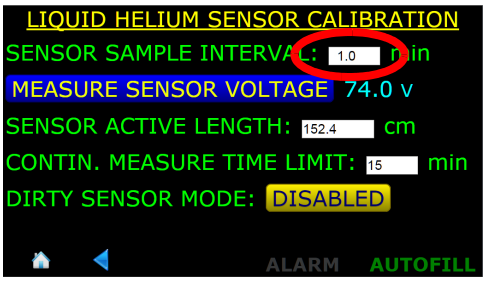


*Figure 4-11.* Enter Liquid Helium Sensor Active Length

### 4.2.3 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**.

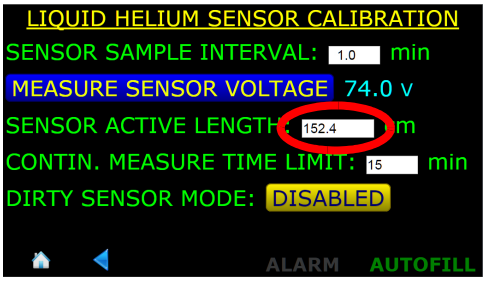


*Figure 4-12.* Enter Liquid Helium Sensor Active Length

### 4.2.4 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.

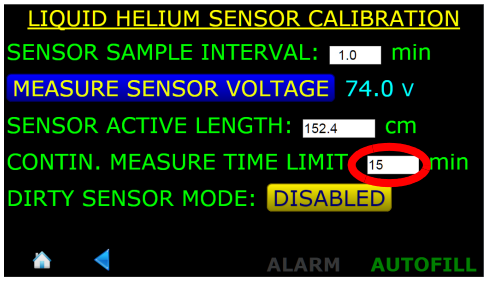


*Figure 4-13.* Enter Liquid Helium Sensor Active Length

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.

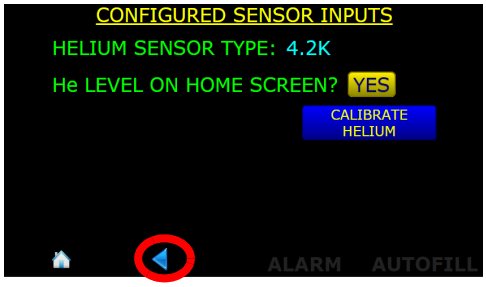


*Figure 4-14.* Footer BACK Button Selection

### 4.2.5 Sensor Name

1. Press the **SYSTEM** button.

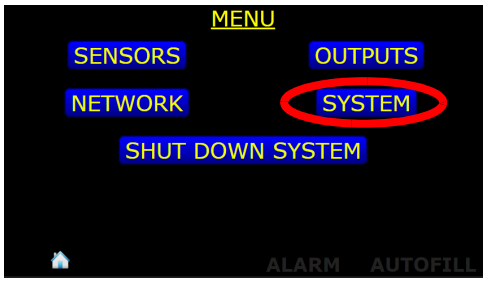


*Figure 4-15.* SYSTEM Menu Selection

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.

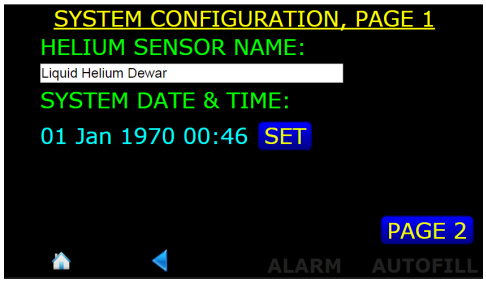


*Figure 4-16.* HELIUM SENSOR NAME: Field

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

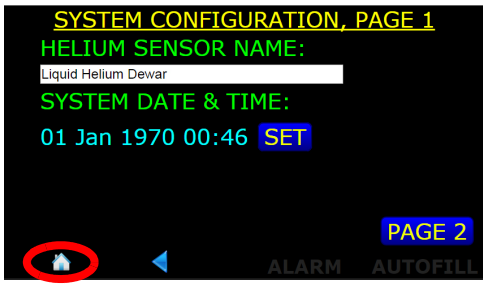


*Figure 4-17.* Home Selection Button

# 5 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 also provided for the serial and Ethernet return data. However, for optimal performance and simplicity of programming, AMI recommends limiting normal operation to one interface. An exception to this recommendation would be using the serial port as a debugging aid during programming of the Ethernet port, or vice-versa, which can prove to be a useful resource.

The Model 1700 also allows a browser connection via TCP/IP. The instrument's IP address can be ascertained by referring to the section titled "IP Addressing Scheme" on page 27. By using a browser to connect to the instrument, all functionality of the Model 1700 can be controlled via the browser.

## 5.1 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.

For example, the command `CONFigure:TIME:DST {0|1}` indicates that the command `CONFigure:TIME:DST` has two parameter options: `0` or `1`. 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.

## 5.2 SCPI Ethernet Communication

The Ethernet port via an RJ-45 connector on the rear of the instrument allows a computer to communicate with the instrument using the SCPI commands described in "Command Set Reference" on page 39. The host computer must run a Telnet program, such as PuTTY[1], and connect to port 7180.

1. http://www.chiark.greenend.org.uk/~sgtatham/putty/

## 5.3 SCPI Serial (RS-232) Communication

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.

### 5.3.1 Serial port connector and cabling

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

The Model 1700 uses three wires of the rear-panel DB25 connector: pin 2 (transmit), pin 3 (receive), and pin 7 (common). There is no software or hardware handshaking. 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). If a serial-to-parallel converter is used, it must be capable of receiving data on pin 3 or the cable connected to the Model 1700 must interchange the wires between pins 2 and 3.

## 5.4 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 an serial transmission. The Model 1700 can accept *<CR>*, *<LF>*, *<CR><LF>*, or *<LF><CR>* as termination characters from an external computer.

The simplest method for communicating with the Model 1700 via RS-232 is by using the interactive mode of a commercially available terminal emulation program. The Model 1700 transmits and receives information at a baud rate of 115,200 and uses 8 data bits, no parity, and 1 stop bit. 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 must wait for the reply from the Model 1700 before sending another command even if the reply consists of only termination characters.* Otherwise, the shared input/output command buffer of the Model 1700 may become corrupted.

The host device can be a standard dot matrix printer connected via a serial-to-parallel converter, or connected directly with a printer capable of receiving serial data. Presumably, any serial-to-parallel converter which can be properly configured is acceptable. AMI has tested the Model 1700

with a standard, low cost converter configured as a DTE device, 115,200 baud, 8 data bits, no parity, and 1 stop bit. In order to communicate with the host device, it is necessary to set the terminal program to the identical baud rate of the host device.

## 5.5 Command Set 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.

### 5.5.1 Commands for determining the instrument configuration

**Command:** N2?
**Function:** Returns a 0 if the instrument is not configured to read liquid nitrogen level, a 1 if it is with the internal oscillator, and a 2 if it is with an external oscillator/transmitter.
**Returns:** 0, 1 or 2<CR><LF>
**Default:** N/A

**Command:** HE?
**Function:** Returns a 0 if the instrument is not configured to read liquid helium level, a 1 if instrument is configured to read 4.2K liquid helium level for sensors of active length ≤ 40 inches, 2 if instrument is configured to read 4.2K liquid helium level for sensors of active length ≤ 80 inches, a 3 if the instrument is configured to read 2K liquid helium level for sensors of active length ≤ 40 inches, 5 if instrument is configured to read 2K liquid helium level for sensors of active length ≤ 80 inches.
**Returns:** 0, 1, 2, 3, 4 or 5<CR><LF>
**Default:** N/A

**Command:** `DISPLAY:N2?`
**Function:** Returns a 0 if the instrument is not configured to display liquid nitrogen level on the home screen and a 1 if it is.
**Returns:** `0` or `1<CR><LF>`
**Default:** N/A

**Command:** `DISPLAY:HE?`
**Function:** Returns a 0 if the instrument is not configured to display liquid helium level on the home screen and a 1 if it is.
**Returns:** `0` or `1<CR><LF>`
**Default :** N/A

**Command:** `UNIT`
**Function:** Returns the current liquid level units in use.
**Returns:** `C, I, or %<CR><LF>`
**Default:** `%`

**Command:** `HE:UNIT?`
**Function:** Returns the current liquid helium level units in use.
**Returns:** `C, I, or P<CR><LF>`
**Default:** `P`

**Command:** `RELAY1:CHannel?`
**Function:** 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.
**Returns:** `0, 1, or 2<CR><LF>`
**Default:** `0`

**Command:** `RELAY2:CHannel?`
**Function:** 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.
**Returns:** `0, 1, or 2<CR><LF>`
**Default:** `0`

**Command:** `FILL:CHannel?`
**Function:** 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.
**Returns:** `0, 1, or 2<CR><LF>`
**Default:** `0`

**Command:** `RELAY1:OPeration?`
**Function:** 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 relay is below the setpoint. By default, relay №1 is configured as the high level relay with alarm condition when level is greater than the setpoint.
**Returns:** `0 or 1<CR><LF>`
**Default:** `0`

**Command:** `RELAY2:OPeration?`
**Function:** 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 relay is above the setpoint. By default, relay №2 is configured as the low level relay with alarm condition when level is less than the setpoint.
**Returns:** `0 or 1<CR><LF>`
**Default:** `0`

**Command:** `HI`
**Function:** Returns the `HI` setpoint limit (default: relay №1) in the current units.
**Returns:** `<value><CR><LF>`
**Default:** `90%`

**Command:** `LO`
**Function:** Returns the `LO` setpoint limit (default: relay №2) in the current units.
**Returns:** `<value><CR><LF>`
**Default:** `10%`

**Command:** `RELAY1:SETpoint?`
**Function:** Returns the Relay №1 setpoint in the current units
**Returns:** `<value><CR><LF>`
**Default:** `90%`

**Command:** `RELAY2:SETpoint?`
**Function:** Returns the Relay №2 setpoint in the current units
**Returns:** `<value><CR><LF>`
**Default:** `10%`

**Command:** A
**Function:** Returns the A setpoint limit (auto fill stop level) in the current units
**Returns:** <value><CR><LF>
**Default:** 80%

**Command:** B
**Function:** Returns the A setpoint limit (auto fill start level) in the current units
**Returns:** <value><CR><LF>
**Default:** 20%

**Command:** INTERVAL
**Function:** Returns the fill timer setting in minutes if the instrument is configured for the nitrogen channel. Returns the sampling interval in minutes if the instrument is configured for the helium channel.
**Returns:** <value><CR><LF>
**Default:** 15

**Command:** HE:INTERVAL?
**Function:** Returns the sampling interval in minutes if the instrument is configured for the helium channel.
**Returns:** <value><CR><LF>
**Default:** 15

**Command:** LENGTH
**Function:** Returns the sensor active length in the current units.
**Returns:** <value><CR><LF>
**Default:** N/A

**Command:** DIRTY_SEN_MODE?
**Function:** Returns a 0 if the instrument's dirty sensor mode is disabled for the helium channel and a 1 if it is enabled.
**Returns:** <value><CR><LF>
**Default:** 0

**Command:** `SOURCE:REC_OUT?`
**Function:** Returns a `0` if the 0-10 $V_{DC}$ 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.
**Returns:** `0, 1, or 2<CR><LF>`
**Default:** `0`

**Command:** `SOURCE:CURRent_LOOP?`
**Function:** 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.
**Returns:** `0, 1, or 2<CR><LF>`
**Default:** `0`

**Command:** `NAME:SENSor:HE?`
**Function:** Returns the name of the helium level sensor.
**Returns:** `<string><CR><LF>`
**Default:** `Helium Level`

**Command:** `SERial_NUMber?`
**Function:** Returns the serial number of the instrument.
**Returns:** `<string><CR><LF>`
**Default:** N/A

**Command:** `HardWare_VERsion?`
**Function:** Returns the hardware version of the instrument.
**Returns:** `<string><CR><LF>`
**Default:** N/A

**Command:** `DATE_MANUFacture?`
**Function:** Returns the date of manufacture of the instrument.
**Returns:** `<string><CR><LF>`
**Default:** N/A

**Command:** `FirmWare_VERsion?`
**Function:** Returns the firmware version of the instrument.
**Returns:** `<string><CR><LF>`
**Default:** N/A

**Command:** `HElium_PowerSupply?`
**Function:** Returns the helium power supply configuration of the instrument where 0 is not installed, 1 is standard, and 2 is XL version.
**Returns:** `0, 1, or 2<CR><LF>`
**Default:** N/A

### 5.5.2 Commands for setting the units of measurement

**Command:** `CM`
**Function:** Sets the liquid level units of measurement to centimeters.
**Returns:** `<CR><LF>`
**Default:** N/A

**Command:** `INCH`
**Function:** Sets the liquid level units of measurement to inches.
**Returns:** `<CR><LF>`
**Default:** N/A

**Command:** `PERCENT`
**Function:** Sets the liquid level units of measurement to percent of active sensor length.
**Returns:** `<CR><LF>`
**Default:** N/A

**Command:** `CONFigure:HE:UNIT <value>`
**Function:** Sets the liquid helium level units of measurement to percent (`0`, or `PERCENT`), centimeters (`1`, or `CM`), or inches (`2`, or `INCH`)
**Returns:** `<CR><LF>`
**Default:** N/A

### 5.5.3 Commands for configuring setpoints

**Command:** `CONFigure:RELAY1:CHannel <value>`
**Function:** Assigns relay 1 to either no channel (disabled) (`0`), nitrogen (`1`), or helium (`2`).
**Returns:** `<CR><LF>`
**Default:** `0`

**Command:** `CONFigure:RELAY2:CHannel <value>`
**Function:** Assigns relay 1 to either no channel (disabled) (0), nitrogen (1), or helium (2).
**Returns:** `<CR><LF>`
**Default:** `0`

**Command:** `CONFigure:RELAY1:OPeration <value>`
**Function:** Configures relay №1 such that it closes (alarms) when the level is ≤ the setpoint (`0`) or ≥ the setpoint (`1`).
**Returns:** `<CR><LF>`
**Default:** `1`

**Command:** `CONFigure:RELAY2:OPeration <value>`
**Function:** Configures relay №2 such that it closes (alarms) when the level is ≤ the setpoint (`0`) or ≥ the setpoint (`1`).
**Returns:** `<CR><LF>`
**Default:** `0`

**Command:** `CONFigure:FILL:CHannel <value>`
**Function:** Assigns the auto fill control relay to either no channel (disabled) (`0`), nitrogen (`1`), or helium (`2`).
**Returns:** `<CR><LF>`
**Default:** `0`
**Note:** If the relay is not assigned to a channel, the units are assumed to be percent.

**Command:** `CONFigure:RELAY1:SETpoint <value>`
**Function:** Configures the relay №1 trip setpoint in the current channel's units.
**Returns:** `<CR><LF>`
**Default:** `20`
**Note:** If the relay is not assigned to a channel, the units are assumed to be percent.

**Command:** `CONFigure:RELAY2:SETpoint <value>`
**Function:** Configures the relay №2 trip setpoint in the current channel's units.
**Returns:** `<CR><LF>`
**Default:** `80`

**Command:** `HI=<value>`
**Function:** Sets the HI setpoint in the current units (Relay №1).
**Returns:** `<CR><LF>`
**Default:** `80`

**Command:** `LO=<value>`
**Function:** Sets the LO setpoint in the current units (Relay №2).
**Returns:** `<CR><LF>`
**Default:** `20`

**Command:** `A=<value>`
**Function:** Sets the A setpoint (control band upper limit).
**Returns:** `<CR><LF>`
**Default:** `60`
**Note:** The A setpoint (autofill stop) must be greater than the B setpoint (fill start) and must also be between 0 and 100%.

**Command:** `B=<value>` or `CONFigure:FILL:B <value>`
**Function:** Sets the B setpoint (control band lower limit).
**Returns:** `<CR><LF>`
**Default:** `40`
**Note:** The B setpoint (autofill start) must be less than the A setpoint (fill stop) and must also be between 0 and 100%.

**Command:** `INTERVAL=<value>`
**Function:** Sets the liquid helium measurement sample interval in minutes.
**Returns:** `<CR><LF>`
**Default:** `10`
**Note:** The maximum value allowable is 600,000 minutes.

**Command:** `CONFigure:INTerval:FILL <value>`
**Function:** Sets the fill timer in minutes.
**Returns:** `<CR><LF>`
**Default:** `15`
**Note:** Setting the value of `FILL` to `0` disables the fill timer function.

**Command:** `CONFigure:INTerval:SAMPle <value>`
**Function:** Sets the liquid helium sampling interval in minutes.
**Returns:** `<CR><LF>`
**Default:** `15`

**Command:** `CONFigure:HE:TIME_LIMIT <value>`
**Function:** Sets the continuous measurement time limit for liquid helium measurements in minutes.
**Returns:** `<CR><LF>`
**Default:** `15`

**Command:** `CONFigure:SOURCE:REC_OUT <value>`
**Function:** Configures the 0-10 Vdc Recorder Output's source to disabled (`0`), assigned to the nitrogen channel (`1`), or the helium channel (`2`).
**Returns:** `<CR><LF>`
**Default:** `0`

**Command:** `CONFigure:SOURCE:CURRENT_LOOP <value>`
**Function:** Configures the 4-20 mA Current Loop's output source to disabled (`0`), assigned to the nitrogen channel (`1`), or the helium channel (`2`).
**Returns:** `<CR><LF>`
**Default:** `0`

**Command:** `SAVE`
**Function:** None. Allows Model 18x and Model 13x backwards compatibility.
**Returns:** `<CR><LF>`
**Default:** `N/A`

### 5.5.4 Commands for setting the channel identifiers

**Command:** `CONFigure:NAME:SENSOR:HE=<"string">`
**Function:** Sets the name of the helium level sensor.
**Returns:** `<CR><LF>`
**Default:** `Helium Level`

### 5.5.5 Commands for making liquid level measurements

**Command:** `LEVEL`
**Function:** Returns the liquid nitrogen or helium level in the current units.
**Returns:** `<value><CR><LF>`
**Default:** N/A

**Command:** `MEASure:HE:LEVel?`
**Function:** Returns the liquid helium level in the current units.
**Returns:** `<value><CR><LF>`
**Default:** N/A
**Note:** If in sample and hold mode, the value returned will be the last sample taken, not a current reading.

**Command:** `MEASure:HE:HOLD`
**Function:** Changes liquid helium level measurement operation from Continuous to Sample and Hold.
**Returns:** `HE:HOLDING<CR><LF>`
**Default:** N/A

**Command:** `MEASure:HE:CONTinuous`
**Function:** Changes liquid helium level measurement operation from Sample and Hold to Continuous mode.
**Returns:** `HE:SAMPLING<CR><LF>`
**Default:** N/A

**Command:** `MEASure:HE:SAMPle`
**Function:** Energizes the liquid helium level sensor, makes a reading and returns to Sample and Hold mode.
**Returns:** `HE:SAMPLED<CR><LF>`
**Default:** N/A

**Command:** `MEASure:ADC0?`
**Function:** Returns the liquid helium level sensor voltage in volts.
**Returns:** `<value><CR><LF>`
**Default:** N/A
**Note:** Will return a value of 0 if the helium level sensor is not energized when the command is issued.

**Command:** `MEASure:ADC1?`
**Function:** Returns the liquid helium sensor power supply voltage in volts.
**Returns:** `<value><CR><LF>`
**Default:** N/A

**Command:** `MEASure:ADC2?`
**Function:** Returns the liquid helium sensor excitation current in milliamperes.
**Returns:** `<value><CR><LF>`
**Default:** N/A

### 5.5.6 Commands for calibrating level sensors

**Command:** `CONFigure:HE:LENGTH=<value>`
**Function:** Configures the liquid helium sensor active length in current units.
**Returns:** `<CR><LF>`
**Default:** N/A
**Note:** Returns -5 if the current units are percent.

**Command:** `LENGTH=<value>`
**Function:** Configures the liquid helium level sensor active length in current units.
**Returns:** `<CR><LF>`
**Default:** N/A

### 5.5.7 System Commands

**Command:** SYStem:BEEPer:IMMediate,<time>
**Function:** The receipt of this command causes an audible tone to be generated by the instrument. Note that this command generates an event and therefore it has no associated SYS:REBOOT state or query form. The duration time parameter is specified in seconds.
**Returns:** <CR><LF>
**Default:** N/A

Command: SYStem:BEEPer:STATe <Boolean>
Function: Enables/disables the beeper. When STATe 0 is selected, no instrument condition, except the :SYSTem:BEEPer:IMMediate command, shall cause an audible beep to be emitted. At SYS:REBOOT, this value is reset to 1.
**Returns:** <CR><LF>
**Default:** 1

**Command:** SYStem:DATE <year>,<month>,<day>
**Function:** <year> as a four-digit number; <month> Range is 1 to 12 inclusive; <day> Number of days in the month.
**Returns:** <CR><LF>
**Default:** N/A

**Command:** SYStem:DATE?
**Function:** Returns the system date.
**Returns:** <year>,<month>,<day><CR><LF>
**Default:** N/A

**Command:** SYStem:KLOCk<Boolean>
**Function:** This command locks the local controls of an instrument. This includes any front panel, keyboard, or other local interfaces. This value cannot be reset to OFF, unless SYSTem:SECurity:STATe is OFF. If SYSTem:SECurity:STATe is OFF, the KLOCk value is set to OFF at SYS:REBOOT. If SYSTem:SECurity:STATe is ON, SYS:REBOOT has no effect.
**Returns:** <CR><LF>
**Default:** OFF

**Command:** SYStem:TIME <hour>,<minute>,<second>
**Function:** This command is used to set the instrument's clock:
<hour> Range is 0 to 23 inclusive.
<minute> Range is 0 to 59 inclusive.

<second> Range is 0 to 60.
The query response message shall consist of three fields separated by commas: <hour>,<minute>,<second>

**Returns:** <CR><LF>
**Default:** N/A

**Command:** SYStem:TIME?
**Function:** This command reads the instrument's clock.
**Returns:** <hour>,<minute>,<second><CR><LF>
**Default:** N/A

**Command:** SYStem:REBOOT
**Function:** This command reboots the instrument.
**Returns:** <CR><LF>
**Default:** N/A

**Command:** SYStem:RESTORE
**Function:** This command reboots the instrument and sets all parameters back to factory defaults.
**Returns:** <CR><LF>
**Default:** N/A

## 5.6 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[a]) setpoint out of range | 0 ≤ LO (or relay №2[a]) ≤ LENGTH |
| -4 | HI (or relay №1[a]) setpoint out of range | 0 ≤ HI (or relay №1[a]) ≤ LENGTH |

| Error Code | Meaning | Valid Range |
|---|---|---|
| -5 | Attempted to set or query for LENGTH in PERCENT units mode | |
| -6 | Invalid argument, value out of maximum calibration range | 1 cm ≤ value ≤ 650 cm |
| -7 | INTERVAL setting out of range | 0 ≤ INTERVAL ≤ 600 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

# 6 Service and Repair

## 6.1 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.

## 6.2 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. |

## 6.3 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.

### 6.3.1 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)

### 6.3.2 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.

## 6.4 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.

### 6.4.1 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)

### 6.4.2 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.

# Appendix

## A.1 Connector Wiring

The following sections document the connector pin outs and pin definitions.

### A.1.1 Serial (RS-232) Connector

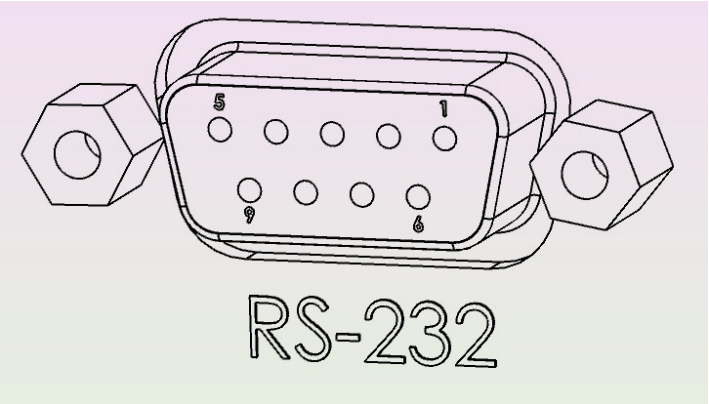


*Figure A-1* Serial (RS-232) Pin Out

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.

*Table A-1* 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 | |

### A.1.2 Ethernet Connector

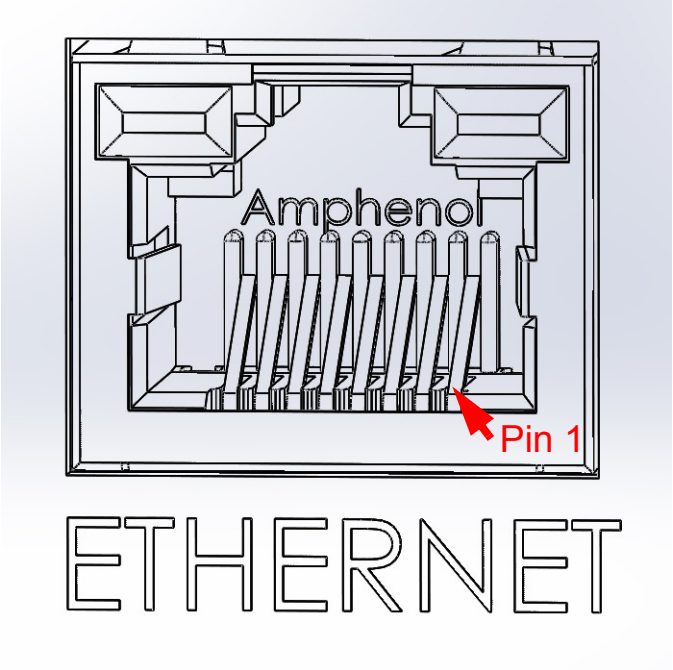


*Figure A-2* Ethernet Connector Socket Pin out

*Table A-2* 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 | | |

### A.1.3 Liquid Helium Connector J1 Wiring


*Figure A-3* Liquid Helium (LHe) Level Sensor Connector

*Table A-3* LHe Level Connector Pin Definitions

| Pin | Function |
|---|---|
| 1 | Sensor I+ (Red) |
| 2 | Not used |
| 3 | Not used |
| 4 | Not used |
| 5 | Not used |
| 6 | Sensor V- (Yellow) |
| 7 | Sensor I- (Black) |
| 8 | Sensor V+ (Blue) |
| 9 | Not used |

### A.1.4 Aux I/O Connector

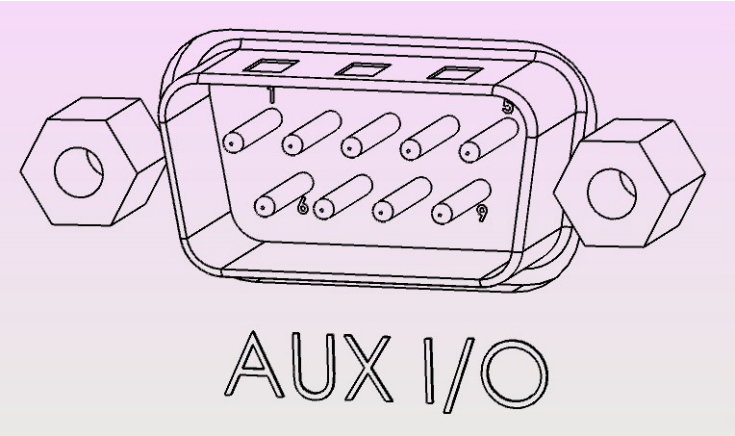


*Figure A-4* Aux I/O Connector

*Table A-4* Aux I/O Pin Definitions

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

## A.2 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**

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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

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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---
```

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# Glossary

## Abbreviations and Acronyms Used in This Manual

| Term | Meaning |
|---|---|
| AC; ac | Alternating Current; strictly, electrical *current* that periodically reverses direction. Typically used also to describe an electrical power source in terms of the *voltage*. 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). |
| 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 |

# Glossary

| Term | Meaning |
|---|---|
| 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 teletypewriter communication. |
| SCPI | Standard Commands for Programmable Instruments |
| V | Volts |
| VA | Volt-amperes (V x I); a unit of electrical reactive power |
| $V_{lead}$ | Voltage (I x R) developed across circuit lead or wiring resistance due to current flow |
| $V_m$ | Magnet voltage |
| $V_s$ | Power supply voltage |

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