CRYOMAGNETICS, INC.
INNOVATIVE TOOLS FOR SCIENTIFIC RESEARCH

# OPERATING INSTRUCTION MANUAL

# FOR THE

# TM-620 TEMPERATURE MONITOR

**03/24/2026**

**Revision 1.06**

**BY**
**CRYOMAGNETICS, INCORPORATED**
**1006 ALVIN WEINBERG DRIVE**
**OAK RIDGE, TENNESSEE 37830**
**+1 (865) 482-9551**
https://www.cryomagnetics.com

# TABLE OF CONTENTS


**TABLE OF CONTENTS** ..... **II**

**LIST OF FIGURES** ..... **III**

**1. INTRODUCTION** ..... **1**

**2. SPECIFICATIONS** ..... **2**

**3. INSTRUMENT SETUP AND SENSOR CONNECTION** ..... **3**

3.1. LINE VOLTAGE AND FUSE ..... 3
3.2. CONNECTING SENSORS, RELAY FUNCTIONS, AND ANALOG OUTPUTS ..... 3

**4. OPERATION AND MENUS** ..... **6**

4.1. MENU ORGANIZATION ..... 6
4.2. TEMPERATURE SENSOR CHANNELS ..... 7
4.2.1. Units ..... 8
4.2.2. Excitation ..... 8
4.2.3. Sensor Curves ..... 8
4.2.4. Alarm Set Points ..... 8
4.3. SETUP MENU ..... 9
4.4. INFO MENU – FIRMWARE UPDATES ..... 9
4.5. ANALOG OUTPUT ..... 10
4.6. TM-620 CIRCUIT DESCRIPTION ..... 10

**5. COMPUTER INTERFACE COMMAND REFERENCE** ..... **11**

5.1. LAN (ETHERNET) INTERFACE ..... 11
5.2. USB INTERFACE ..... 11
5.3. GPIB (IEEE-488.2) INTERFACE ..... 11
5.4. HTTP INTERFACE ..... 12
5.5. COMMAND REFERENCE ..... 12
5.6. ERROR HANDLING AND COMMAND AVAILABILITY ..... 13
5.7. COMMAND REFERENCE ..... 15

**6. LINE VOLTAGE CONTROLLER MODULE – OPTION 4** ..... **24**

6.1. OVERVIEW ..... 24
6.2. CONNECTIONS ..... 24
6.3. FUSES ..... 24
6.4. THEORY OF OPERATION ..... 24

**7. FACTORY CALIBRATION / FIRMWARE UPDATES** ..... **25**

7.1. OVERVIEW ..... 25
7.2. FIRMWARE UPDATES ..... 25
7.3. BUILT IN SENSOR TEMPERATURE CURVES ..... 26

**8. LIMITED WARRANTY POLICY** ..... **27**

**9. FACTORY CALIBRATIONS, INSTALLED OPTIONS AND CERTIFICATION** ..... **28**

# LIST OF FIGURES

**Figure 1: - Sensor Connector Wiring (DB-9M) ..... 3**
**Figure 2: - Auxiliary Connector Wiring – Switchcraft ..... 4**
**Figure 3: - Typical Model TM-620 Display (with Four Channel Option) ..... 6**
**Figure 4: TM-620 Menu Hierarchy ..... 7**
**Figure 5: Channel Menu ..... 8**
**Figure 6: Setup Menu ..... 9**
**Figure 7: Firmware Update Display ..... 10**

# 1. Introduction

The TM-620 Cryogenic Temperature Monitor is the most advanced instrument for monitoring cryogenic temperature sensors available today. Its versatile architecture allows configuration to read temperatures from room temperature to 1 Kelvin using a variety of temperature sensors.




The TM-620 is available in two-channel or four-channel versions. With either option, the instrument has independent input channels that are factory configurable to either the same or different temperature sensors. The unit is compatible with any positive or negative coefficient temperature sensor which can operate using a constant current excitation of 1mA, 100uA, or 10uA. Virtually all cryogenic temperature sensor manufacturers can use this technology, so the TM-620 can be used with most existing equipment. Flexible calibration procedures allow the use of two, three, or four wire temperature sensors.

Also included are fully adjustable alarms for each channel. The alarm can be used to alert the user (audibly and visually) to a problem with the system, and to automatically take action (relay contacts are provided).

Unique features of the TM-620 include a user adjustable current source. This allows for any sensor type to be used on any channel.
Computer control of the TM-620 is possible via USB and Ethernet interfaces – both are provided in the standard configuration. IEEE-488 is also available as an option. LabVIEW® virtual instrument drivers are available to allow computer control via a familiar, intuitive interface. A wide variety of other options are also available that allow the instrument to be upgraded and tailored to your particular requirements.

# 2. Specifications

## Common Specifications

| | |
|---|---|
| Display Update Rate: | ~ 500ms Intervals |
| Control/ Alarm Relay Voltage Rating | 100V |
| Control/ Alarm Relay Current Rating | 135mA |
| 12V Loop Source | 100mA maximum |
| 4-20mA Analog Output Loop Power | 24V maximum |
| 0-10V Analog Output | 1 mA maximum |
| AC Input: | 100-240V a.c., 50-60 Hz, 30 Watts |
| Operating Temperature: | 15 °C to 35 °C |
| Relative Humidity | 10% to 95%, non-condensing |
| Overall Dimensions: | 185 mm W X 67 mm H X 197 mm D |
| Weight: | 1.0 kg |
| USB interface: | USB 1.1/2.0 Full-Speed |
| IEEE-488 interface: | IEEE-488.2-1992 Standard |
| Ethernet: | IEEE-802.3 10/100 BASE-T |

## Channel Specifications

| | |
|---|---|
| Maximum Sensor Resistance | 10K ohms |
| Measurement Resolution | 0.1 ohm or 0.1 percent of maximum resistance |
| Measurement Accuracy | +/- 0.5% FS |
| Excitation Currents | 1mA, 100µA, 10 µA |

## Model Configurations

| | |
|---|---|
| TM-620-2 | Two Channel Setup |
| TM-620-4 | Four Channel Setup |

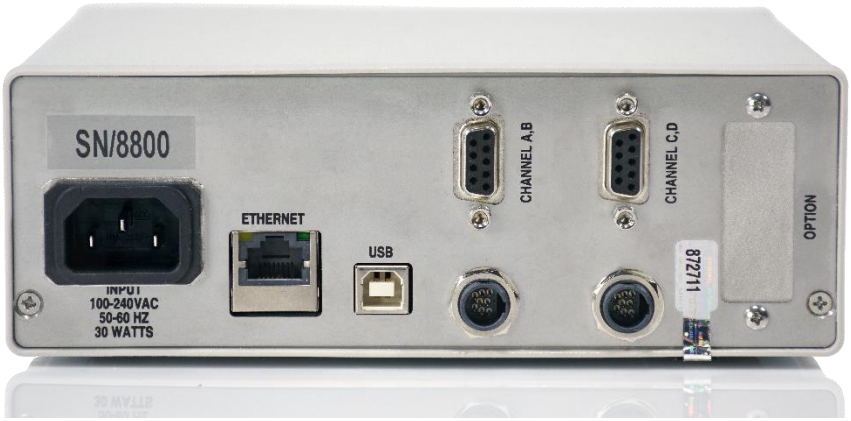
## Optional Equipment

| | |
|---|---|
| TM-620-x-1 | IEEE-488 Interface |
| TM-620-x-2 | RS-232 Interface |
| TM-620-x-3 | 19” Rack Mountable Cabinet |

The TM-620 is designed to operate per the specifications in this table and the instructions provided in this manual. Other use may impair the safety protections provided by the equipment.

# 3. Instrument Setup and Sensor Connection

The TM-620 is delivered to you fully tested and ready to operate. This includes sensor calibration if Cryomagnetics supplied the sensor(s) with the instrument.



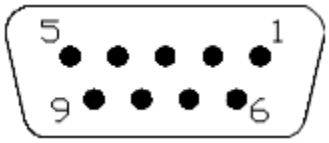

## 3.1. Line Voltage and Fuse

The TM-620 is designed to operate with any AC power source between 100V and 240V A.C. and 50 to 60 Hz. No user serviceable fuse is provided.

## 3.2. Connecting Sensors, Relay functions, and Analog Outputs

Sensors connect to the TM-620 at the rear panel using the DB9 connectors located above the labels ‘Channel A/B’ and ‘Channel C/D’. **Figure 3.1** indicates the pin designations for the sensor connectors.

**Figure 1: - Sensor Connector Wiring (DB-9M)**



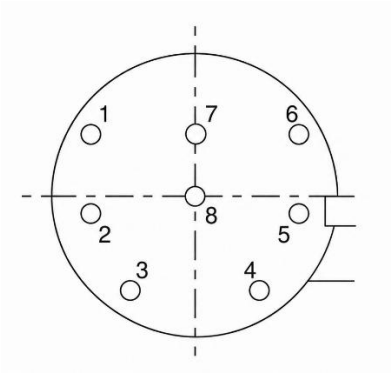
| Pin # | Function: | Pin # | Function: |
|---|---|---|---|
| 1 | Voltage Sense (V+) – Ch B/D | 6 | Excitation Current (I+) – Ch B/D |
| 2 | Voltage Sense (V-) – Ch B/D | 7 | Excitation Current (I-) – Ch B/D |
| 3 | Shield (Ground) | 8 | Excitation Current (I+) – Ch A/C |
| 4 | Voltage Sense (V+) – Ch A/C | 9 | Excitation Current (I-) – Ch A/C |
| 5 | Voltage Sense (V-) – Ch A/C | | |

********** **IMPORTANT** **********

***1) Connections should NEVER be made directly to the connector on the rear panel. Always solder to a mating connector that is not attached to the unit. Connections should be double-checked for accuracy prior to attaching to the TM-620 and powering the unit ON.***

Each input channel of the TM-620 also has a dedicated 8 pin circular connector. This connector provides access to the alarm relay functions and the 4-20mA analog output. **Figure 3.2** indicates the pin designations for the auxiliary connector.

**Figure 2: - Auxiliary Connector Wiring – Switchcraft**




View Facing Rear Panel Connector

| Pin # | Function: | Pin # | Function: |
|---|---|---|---|
| 1 | Alarm Relay Ch B – Contact (+) (NO) | 5 | Alarm Relay Ch A – Contact (-) (NO) |
| 2 | 4-20mA Ch B Analog Output (+) | 6 | 4-20mA Ch A Analog Output (+) |
| 3 | Alarm Relay Ch B – Contact (-) (NO) | 7 | 4-20mA Ch B Analog Output (-) |
| 4 | 4-20mA Ch A Analog Output (-) | 8 | Alarm Relay Ch A – Contact (+) (NO) |

Cryomagnetics' temperature sensors have four (4) lead wires and use either #30 AWG Teflon insulated lead wires or color-coded phosphor-bronze lead wires (either option may be specified when the sensor is ordered). The connector pin connections and standard color codes for lead wires are shown below.

Some temperature sensors made by Cryomagnetics may have only 2 or 3 lead wires. If the sensor has 3 lead wires, the I- and V- leads are typically combined into a single black lead which should be jumped to both the I- and V- pins at the connector. If the sensor has 2 lead wires, the I- and V- leads are combined into a single black lead and the V+ and I+ leads are combined into a single red lead. In this case the I- and V- should be connected to the appropriate pins on the back of the connectors as should the I+ and V+ pins.

Cabling between the temperature sensor and the TM-620 should be of appropriate thickness such that significant voltage-drop across the I+ and I- leads does not occur. It is recommended that cables up to 5 meters in length be #18 AWG wire minimum. Cables from 5 to 15 meters in length should be #16 AWG minimum, and cables from 15 to 30 meters should be #14 AWG minimum. Unshielded cable may be used where no significant use of SCR-controlled equipment or intense electrostatic field sources are present. Otherwise, it is recommended that shielded cable be used.

# 4. Operation and Menus

Setup of the TM-620 can be performed either through the front panel keypad and simple menu instructions or through remote computer interface (USB, Ethernet or IEEE-488.2). Sensor set up and calibration is only supported through the front panel keypad. The following sections contain detailed descriptions of how to set up different sensor types, adjust alarms, and configure the controller functions.

Before connecting any temperature sensors or other cabling to the TM-620, connect the power cord provided with your TM-620 to an appropriate power source. Power the instrument ON and familiarize yourself with the display. If your TM-620 is configured for dual sensor inputs, the top half of the display will indicate Sensor A and the bottom half will indicate Sensor B. If your TM-620 is configured for four sensor inputs, the display will only indicate four sensors, A, B, C, & D.

**Figure 3: - Typical Model TM-620 Display (with Four Channel Option)**

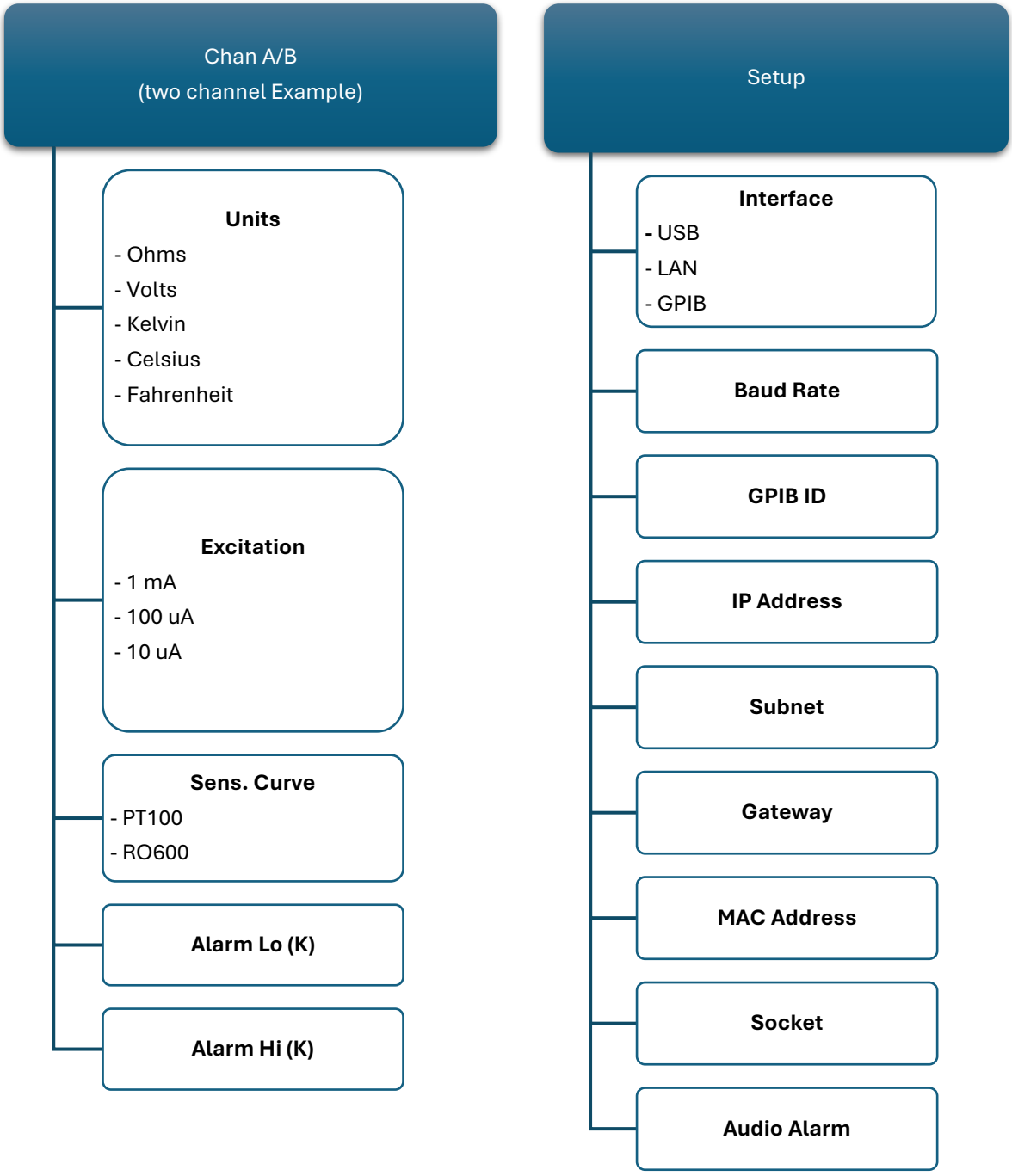



Alarm high and low set points may be entered in the TM-620. Setting the high alarm at 100% and the low alarm at 0% removes the caret symbol from the display.

## *4.1. Menu Organization*

The menus of the TM-620 are designed to minimize the number of keystrokes required, while at the same time being intuitive for system operators. The temperature monitor menu options are accessed by pressing the [Menu] button on the keypad and using the ◄► keys to highlight the desired channel tab. General instrument setup options are accessed by highlighting the Setup tab.

**Figure 4: TM-620 Menu Hierarchy**




## *4.2. Temperature Sensor Channels*

The TM-620 uses dual channel cards to read the temperature sensors. Channels A and B are read from one card while channels C and D are read from the second. Each channel can be configured independently on the channel card's menu. The above diagram indicates options and the menu headings under which they are found. A description of the menu items is outlined below.

**Figure 5: Channel Menu**




### 4.2.1. Units

In the Units menu item, the user can select from Ohms, Volts, Kelvin, Celsius, and Fahrenheit. With the Ch A/B tab selected, press ► or ▼to highlight the desired channels units. Pressing [Enter] while the appropriate unit is selected toggles the units between Ohms, Volts, Kelvin, Celsius, and Fahrenheit. The display will indicate the selected unit.

### 4.2.2. Excitation

The TM-620 includes 3 DC excitation levels that can be configured in the main menu for each channel. These are 1 mA, 100 µA, and 10 µA. Typically, the 1 mA setting is used for PT100 (100-ohm platinum) temperature sensors, while the 10 µA setting are typically used with RO600's (1000 ohm Ruthenium Oxide) at temperatures below 20K. The 100µA setting can be used with RO600's above 20K.

### 4.2.3. Sensor Curves

Currently, only two sensor curves are preloaded into the TM620: the PT100 and the RO600. Contact Cryomagnetics if other curves are desired as these can be downloaded to the instrument.

### 4.2.4. Alarm Set Points

The TM-620 has alarm set points that may be used to alert the operator when the temperature falls out of range of a user-settable threshold. The set points for the high and low alarms (entered in Kelvin) are set in the "Alarm Lo" and "Alarm Hi" fields in the TM-620 menu. Separate set points are available for each channel. The alarm function gives a front panel display indication when activated and an audible alarm will sound. The audible alarm can be silenced by pressing any front panel key on the TM-620; however, the visual indication of the alarm condition is maintained until the temperature is read by the TM-620 and is found to be within the alarm level set points.

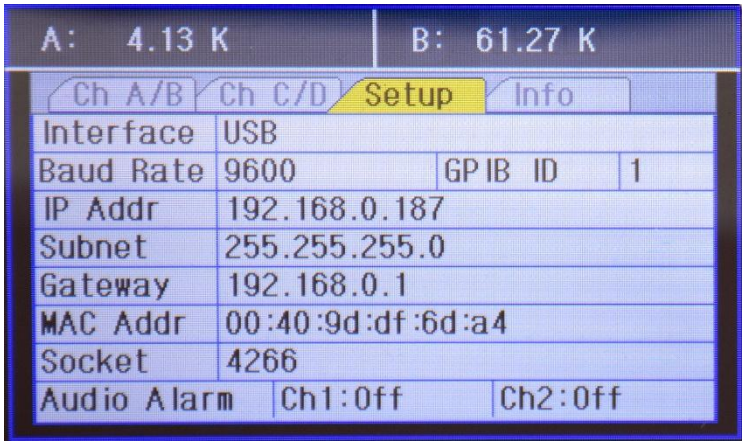
If the low alarm is set to 0% or the high alarm is set to 100%, the associated alarm is disabled. If both the high

and low alarms are enabled, the alarm will be active if the temperature is below the low alarm or above the high alarm set points.

## 4.3. Setup Menu

The TM-620 has numerous general setup parameters that may be configured in the Setup tab.

**Figure 6: Setup Menu**




The user may select which type of interface is used for communication with the TM-620. USB (virtual comm port) and LAN (Ethernet) interfaces are standard with all instruments. The GPIB (IEEE-488.2) interface is optional. To select which interface is active, select the Interface in the Setup tab and press [Enter] to toggle through the options. Note that per IEEE-488.2 specifications, after changing the interface, power to the TM-620 must be cycled before the interface will become active.

Other settings that are adjustable in the Setup menu include baud rate for USB's virtual comm port, GPIB ID, IP address, subnet mask, gateway, and socket (port) for LAN communications. The MAC address is also shown in this menu but is not user configurable.

For detailed information concerning communicating with the TM-620, refer to Appendix A, the Computer Interface Command Reference section of this manual.

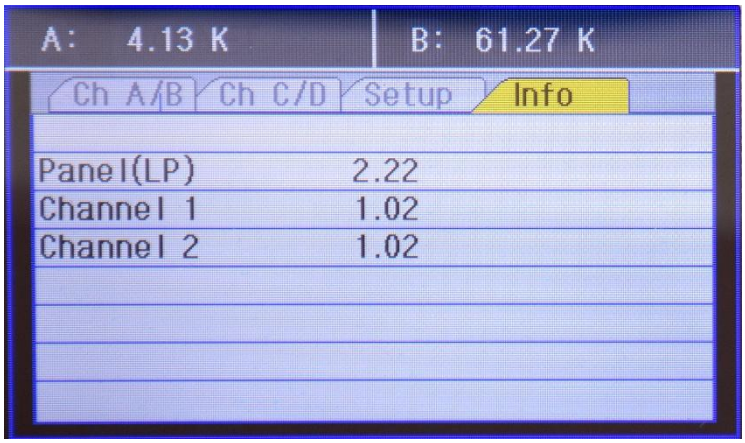
The audible alarm(s) for the TM-620 may also be disabled or enabled in the Setup menu.

## 4.4. Info Menu – Firmware Updates

The TM-620 has a menu for showing the front panel and channel card firmware. The TM-620 has several processors. The Ethernet module is the starting point for loading new instrument firmware. The version identifiers of the installed firmware and version numbers of firmware loaded into the Ethernet module are shown

on this display. The user will be prompted to install firmware updates when different firmware is loaded and this display is accessed. Refer to Appendix C for detailed instructions.

**Figure 7: Firmware Update Display**




## 4.5. Analog Output

Each sensor channel on the TM-620 includes 4-20mA analog outputs. The signals are accessed through the 8-pin Switchcraft connector on the TM-620 rear panel (see **Figure 3.1**). Analog output signals are linear and proportional to the sensor reading in Kelvin from 0 to 300K.

## 4.6. TM-620 Circuit Description

The TM-620 is primarily based on Cypress PSoC5 and PSoC3 microprocessor technology. These state-of-the-art devices contain configurable digital and analog circuitry as well as microprocessors that have built-in FLASH and EEPROM memory used to hold factory calibration and configuration data, as well as user entered calibration and setup information. Also included is an Ethernet interface module that enables firmware updates for all the onboard processors to be easily and reliably installed in the field. The TM-620's display is a bright 240x400 TFT LCD unit having high contrast and a wide viewing angle.

The front panel PSoC5 processor controls the display, keypad, and user communication interfaces. It also controls PSoC-based channel cards that provide sensor excitation, monitoring, analog outputs, and control and alarm relay outputs. Due to the flexibility and stability of the TM-620's circuits, very high resolution and accuracy is achieved. The instrument also provides a card slot for an optional GPIB or RS232 interface.

# 5. Computer Interface Command Reference

Front panel functions of the TM-620 may be accessed using command strings over the selected computer interface. The following sections detail available commands and required syntax.

The commands available through USB and LAN (Ethernet) are identical to those available through IEEE-488.2; however, some commands may be IEEE-488.2 specific and may not provide responses consistent with the USB and LAN interfaces. The command set includes Local, Remote, and RWLock which are not applicable to IEEE-488.2.

Command strings are normally limited to 120 characters when the USB and Ethernet interfaces are used. A <RETURN> will be generated internally when any line longer than the maximum is encountered, and any valid commands in the received line prior to the internally generated <RETURN> will be processed. All remote commands are case insensitive, allowing upper or lower case to be used without affecting operation of the commands.

When the USB interface is selected, all commands sent to the instrument will be echoed including the terminating ASCII <RETURN> character, followed by a <NEWLINE> character when command processing is complete.

## 5.1. LAN (Ethernet) Interface

The LAN interface is implemented using sockets for remote commands and status. Network parameters are configured in the "SETUP" menu. Commands and responses are formatted the same as for GPIB and USB. LabVIEW and HyperTerminal are convenient tools for using this interface.

## 5.2. USB Interface

The USB port is accessed through the USB Type B connector on the rear panel of the instrument. To use the USB interface, you must install a virtual com port on the PC, which then treats the USB interface as a traditional RS-232 interface. The virtual com port driver is available from Cryomagnetics or from www.ftdichip.com. The TM-620 must be configured for the same baud rate as your virtual com port (See section 4.3 - Setup menu). The baud rate may be set to 9600, 19200, 38400, 57600 or 115200. Factory default is 9600.

## 5.3. GPIB (IEEE-488.2) Interface

The optional TM-620 GPIB interface implements SH1, AH1, T6, L4, SR1, RL0, RL1, PP0, DC1, DT0, C0, and E1 options. The commands are compliant with the IEEE-488.2 standard. The connector is identified on the rear

panel of the instrument as the OPTION connector.

**Reference:** IEEE Standard Codes, Formats, Protocols, and Common Commands (IEEE Std 488.2-1992) provides a detailed description of the IEEE common commands (identifiable in the command list by the asterisk as the first character.)

The command list and structure is identical to the RS-232 command set. IEEE-488.2 device address may be selected from 0 - 31. Factory default is 0.

## 5.4. HTTP Interface

An HTTP interface is provided for the TM-620 to allow simple remote monitoring of sensor readings. To use this capability the login “root” and password “update” should be used.

The HTTP interface is also used to load new firmware updates to the instrument when they are available. To avoid damaging the instrument’s operating firmware a different login and password is required. This is provided with the firmware update when it is available.

## 5.5. Command Reference

Commands available over the computer interface are separated into commands that are IEEE 488.2 specific, commands that are inhibited when the operator menu is accessed, and commands that are always available. All command mnemonics that elicit a response from the instrument end with a question (?) character. The general command format is as follows:

<Subcommand1>;<subcommand2>;<subcommand3><RETURN>

where a subcommand is formatted:

<Command Mnemonic><SPACE><Parameter>

Example:

*IDN?;CHAN 2;UNITS CM;UNITS?<RETURN>

Semicolons separate responses to each subcommand. The above example would return:

*IDN?;CHAN 2;UNITS CM;UNITS?<RETURN><LINEFEED>

Cryomagnetics,TM-620,2002,2.00;cm<RETURN><LINEFEED>

where the serial number is 2002 and the firmware version number is 2.00.

## 5.6. Error Handling and Command Availability

The ERROR command allows error messages to be enabled or disabled when the USB or RS-232 interface is used. The IEEE-488.2 status mechanisms may always be used to determine if an error occurred processing a command, and the category of the error. Some commands are unavailable if an operator at the instrument is accessing the instrument menu. If a command available only in operate mode is received while the menus are being accessed, a device-dependent error is reported in the Extended Status Register (ESR), and the message "Blocked by menu" will be returned if error reporting is enabled when using the RS-232 interface.

The following table lists the TM-620 commands, shows the TM-620 mode and channel where the command may be used, and provides a short command description. Command details are provided in the reference that follows.

| Command | Available | Description |
|---|---|---|
| CHAN | Operate | Select instrument channel for computer commands |
| CHAN? | Operate | Query selected channel |
| ERROR | Operate | Set error response mode for RS-232 interface |
| ERROR? | Always | Query error response mode |
| H-ALM | Operate | Set high alarm threshold |
| H-ALM? | Operate | Query high alarm threshold |
| L-ALM | Operate | Set low alarm threshold |
| L-ALM? | Operate | Query low alarm threshold |
| LOCAL | Always | Return control to front panel (RS-232 Only) |
| MEAS | Operate | Start measurement on selected channel |
| MEAS? | Operate | Query last completed measurement on selected channel |
| REMOTE | Operate | Select remote operation (RS-232 Only) |
| RWLOCK | Operate | Select remote operation with front panel lock (RS-232 Only) |
| STAT? | Always | Query instrument status |

| Command | Available | Description |
|---|---|---|
| TYPE? | Operate | Query channel type for selected channel |
| UNITS | Operate | Select units for selected channel |
| UNITS? | Operate | Query selected units for selected channel |
| *CLS | Always | Clear Status Command |
| *ESE | Always | Standard Event Status Enable Command |
| *ESE? | Always | Standard Event Status Enable Query |
| *ESR? | Always | Standard Event Status Register Query |
| *IDN? | Always | Identification Query |
| *OPC | Always | Operation Complete Command |
| *OPC? | Always | Operation Complete Query |
| *RST | Always | Reset Command |
| *SRE | Always | Service Request Enable Command |
| *SRE? | Always | Service Request Enable Query |
| *STB? | Always | Read Status Byte Query |
| *TST? | Always | Self-Test Query |
| *WAI | Operate | Wait-to Continue Command |

## 5.7. Command Reference

This section describes how each TM-620 command is used and provides a cross-reference to related commands. The command syntax sections show required elements enclosed in <angle brackets> and optional parameters enclosed in [square brackets]. All numbers are decimal (base 10).

---

**CHAN** Select instrument channel for computer commands

**Availability:** Operate Mode

**Command Syntax:** CHAN <Selected Channel>

**Example:** CHAN B

**Parameter Range:** A, B, C, D

**Description:** The CHAN command selects the default channel for future computer commands. The default channel is set to 1 when power is applied or when the *RST command is sent.

**Related Commands:** CHAN?, H-ALM, H-ALM?, L-ALM, L-ALM?,MEAS, MEAS?, TYPE?, UNITS, UNITS?, *RST

---

**CHAN?** Query selected channel

**Availability:** Operate Mode

**Command Syntax:** CHAN?

**Response:** <Channel number>

**Response Example:** 1 **Response Range:** 1 or 2

**Description:** The **CHAN?** query returns the default channel for future computer commands. The default channel is set to 1 when power is applied or when the *RST command is sent.

**Related Commands:** BOOST, BOOST?, CHAN?, FILL, FILL?, H-ALM, H-ALM?, HIGH, HIGH?, INTVL, INTVL?, L-ALM, L-ALM?, LNGTH?, LOW, LOW?, MODE, MODE?, MEAS, MEAS?, TYPE?, UNITS, UNITS?, *RST

---

**ERROR** Set error response mode for RS-232 interface

**Availability:** Operate Mode

**Command Syntax:** ERROR <Error Mode>

**Example:** ERROR 1

**Parameter Range:** 0 or 1 (0 - disable error reporting, 1 - enable error reporting)

**Description:** The **ERROR** command enables or disables error messages when a serial interface is used. It is much easier to handle errors under program control when using a serial interface if error messages are disabled, but it is desirable to enable error messages if a terminal program is used to interactively control and

query the TM-620. The last ERROR setting will be retained even when the instrument is off. It will power up as configured by the last ERROR command.

**Related Commands:** ERROR?

---

**ERROR?** Query error response mode

**Availability:** Always

**Command Syntax:** ERROR?

**Response:** <Error Mode>

**Response Example:** 0 **Response Range:** 0 or 1

**Description:** The **ERROR?** query returns the selected error reporting mode.

**Related Commands:** ERROR

---

**H-ALM** Set high alarm threshold

**Availability:** Operate Mode

**Command Syntax:** H-ALM [Alarm Level]

**Example:** H-ALM 65.0

**Default Parameter:** 100.0 (Off) **Parameter Range:** 0 to Sensor Length

**Description:** The **H-ALM** command sets the threshold for the high alarm in the present units for the selected channel. If the liquid level rises above the threshold the alarm will be activated. The alarm will be disabled if the threshold is set to 100.0.

**Related Commands:** H-ALM?, CHAN, CHAN?, LNGTH?, UNITS, UNITS?

---

**H-ALM?** Query high alarm threshold

**Availability:** Operate Mode

**Command Syntax:** H-ALM?

**Response:** <Alarm Level> <Units>

**Response Example:** 15.0 cm **Response Range:** 0 to Sensor Length

**Description:** The **H-ALM?** query returns the high alarm threshold in the present units for the selected channel.

**Related Commands:** H_ALM, CHAN, CHAN?, LNGTH?, UNITS, UNITS?

---

**L-ALM** Set low alarm threshold

**Availability:** Operate Mode

**Command Syntax:** L-ALM [Alarm Level]

**Example:** L-ALM 65.0

**Default Parameter:** 0.0 (Off) **Parameter Range:** 0 to Sensor Length

**Description:** The **L-ALM** command sets the threshold for the low alarm in the present units for the selected channel. If the liquid level rises above the threshold the alarm will be activated. The alarm will be disabled if the threshold is set to 0.0.

**Related Commands:** L-ALM?, CHAN, CHAN?, LNGTH?, UNITS, UNITS?

---

**L-ALM?** Query low alarm threshold

**Availability:** Operate Mode

**Command Syntax:** L-ALM?

**Response:** <Low Alarm Level> <Units>

**Response Example:** 15.0 cm **Response Range:** 0 to Sensor Length

**Description:** The **L-ALM?** query returns the low alarm threshold in the present units for the selected channel.

**Related Commands:** L_ALM, CHAN, CHAN?, LNGTH?, UNITS, UNITS?

---

**LOCAL** Return control to front panel

**Availability:** Always (RS-232 Only)

**Command Syntax:** LOCAL

**Description:** The **LOCAL** command returns control the front panel keypad after remote control has been selected by the REMOTE or RWLOCK commands.

**Related Commands:** REMOTE, RWLOCK

---

**MEAS** Start measurement on selected channel

**Availability:** Operate Mode

**Command Syntax:** MEAS [Channel #]

**Example:** MEAS B

**Default Parameter:** Default Channel (See CHAN) **Parameter Range:** A, B, C, D

**Description:** The MEAS command starts a measurement on the selected channel. The DATA READY bit for the selected channel will be set in the status byte returned by the *STB? command when the measurement is complete.

**Related Commands:** CHAN, CHAN?, MEAS?, *STB?

---

**MEAS?** Query last completed measurement on selected channel

**Availability:** Operate Mode

**Command Syntax:** MEAS? [Channel #]

**Example:** MEAS? B

**Default Parameter:** Default Channel (See CHAN) **Parameter Range:** A, B, C, D

**Response:** <Measured Level> <Units>

**Response Example:** 122.2 K

**Description:** The **MEAS?** query returns latest reading in the present units for the selected channel. If a reading for the selected channel is in progress, the previous reading is returned.

**Related Commands:** CHAN, CHAN?, MEAS, *STB?

---

**REMOTE** Select remote operation

**Availability:** Operate (RS-232 Only)

**Command Syntax:** REMOTE

**Description:** The **REMOTE** command takes control of the TM-620 via the remote interface. All buttons on the front panel are disabled except the Local button. This command will be rejected if the menu system is being accessed via the front panel or if LOCAL has been selected via the Local button on the front panel. Pressing the Local button again when the menu is not selected will allow this command to be executed. This command is only necessary for RS-232 operation since the IEEE-488 RL1 option provides for bus level control of the Remote and Lock controls.

**Related Commands:** LOCAL, RWLOCK

---

**RWLOCK** Select remote operation

**Availability:** Operate (RS-232 Only)

**Command Syntax:** RWLOCK

**Description:** The **RWLOCK** command takes control of the TM-620 via the remote interface. All buttons on the front panel are disabled including the Local button. This command will be rejected if the menu system is being accessed via the front panel or if LOCAL has been selected via the Local button on the front panel. Pressing the Local button again when the menu is not selected will allow this command to be executed. The RWLOCK command is only necessary for RS-232 operation since the IEEE-488 RL1 option provides for bus level control of the Remote and Lock controls.

**Related Commands:** LOCAL, REMOTE

---

**STAT?** Query instrument detailed status

**Availability:** Always

**Command Syntax:** STAT?

**Response:** <Ch 1 Detailed Status>,<Ch 2 Detailed Status>,<Menu Mode>

**Response Example:** 8,3,0 **Response Range:** 0,0,0 to 127,127,1

**Description:** The **STAT?** query returns detailed instrument status as decimal values, and the status of local menu selection. When an operator selects the Menu, the instrument is taken out of operate mode, and <Menu Mode> is returned as 1. <Menu Mode> is returned as 0 when in operate mode. Channel detailed status is returned as a decimal number where each bit indicates a status condition of the channel. The meaning of each bit when set to one is shown:

Channel Detailed Status:

```
0   X   X   X   X   X   X   X
    |   |   |   |   |   |   |_____ Read in progress
    |   |   |   |   |   |_________ Refill active
    |   |   |   |   |_____________ Refill timeout occurred
    |   |   |   |_________________ Auto refill is inhibited by low = 0.0 or timeout
    |   |   |_____________________ Alarm limit is exceeded
    |   |_________________________ Open sensor was detected
    |_____________________________ Burnout condition was detected
```

**Related Commands:** *STB?

---

**TYPE?** Query channel type for selected channel

**Availability:** Operate Mode

**Command Syntax:** TYPE? [Channel]

**Example:** TYPE? 2

**Default Parameter:** <Default Channel> **Parameter Range:** 1 or 2

**Response:** <Channel Type>

**Response Example:** 1 **Response Range:** 0 - 3

**Description:** The **TYPE?** query returns a code for the channel type of the designated channel, or the channel type of the default channel set by the CHAN command if a channel is not specified. 0 denotes a liquid helium level sensor, 1 denotes a liquid nitrogen level sensor, 2 denotes an helium recondenser controller and 3 denotes a temperature sensor.

**Related Commands:** CHAN, CHAN?

---

**UNITS** Select units for selected channel

**Availability:** Operate Mode

**Command Syntax:** UNITS <Unit Selection>

**Example:** UNITS Ohms

**Parameter Range:** OHMS, VOLTS, KELVIN, CELSIUS, FARHENHEIT

**Description:** The **UNITS** command sets the units to be used for all input and display operations for the default channel selected by a prior CHAN command.

**Related Commands:** H-ALM, H-ALM?, CHAN, CHAN?, L-ALM, L-ALM?, MEAS, MEAS?, UNITS?

---

**UNITS?** Query selected units for selected channel

**Availability:** Operate Mode

**Command Syntax:** UNITS?

**Parameter Range:** OHMS, VOLTS, KELVIN, CELSIUS, FARHENHEIT

**Response:** <Selected Units>

**Response Example:** OHMS **Response Range:** OHMS, VOLTS, KELVIN, CELSIUS, FARHENHEIT

**Description:** The **UNITS?** command returns the units used for all input and display operations for the default channel selected by a prior CHAN command. Units may be set to centimeters, inches, or percentage of sensor length.

**Related Commands:** H-ALM, H-ALM?, CHAN, CHAN?, L-ALM, L-ALM?, MEAS, MEAS?, UNITS?

---

***CLS** Clear Status Command

**Availability:** Always

**Command Syntax:** *CLS

**Description:** The ***CLS** command operates per IEEE Std 488.2-1992 by clearing the Standard Event Status Register (ESR) and resetting the MAV bit in the Status Byte Register (STB).

**Related Commands:** None

---

***ESE** Standard Event Status Enable Command

**Availability:** Always

**Command Syntax:** *ESE <mask>

**Example:** *ESE 255

**Default Parameter:** 0 **Parameter Range:** 0 to 255

**Description:** The ***ESE** command operates per IEEE Std 488.2-1992 by setting the specified mask into the Standard Event Status Enable Register (ESE).

**Related Commands:** *ESE?

---

***ESE?** Standard Event Status Enable Query

**Availability:** Always

**Command Syntax:** *ESE?

**Response:** <ESE Mask>

**Response Example:** 255 **Response Range:** 0 to 255

**Description:** The ***ESE?** command operates per IEEE Std 488.2-1992 by returning the mask set in the Standard Event Status Enable Register (ESE) by a prior *ESE command.

**Related Commands:** *ESE

---

***ESR?** Standard Event Status Register Query

**Availability:** Always

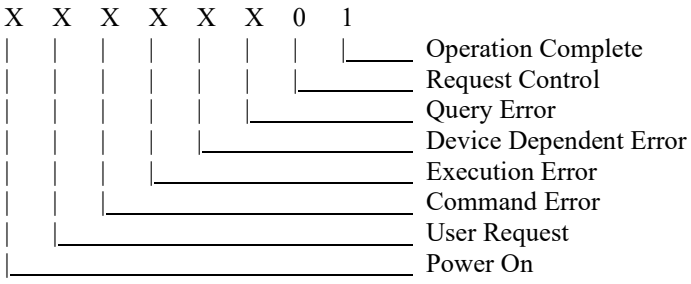
**Command Syntax:** *ESR?

**Response:** <Standard Event Status Register>

**Response Example:** 128 **Response Range:** 0 to 255

**Description:** The ***ESR?** command operates per IEEE Std 488.2-1992 by returning the contents of the Standard Event Status Register and then clearing the register.

Status Byte Bit Allocations:




**Related Commands:** *ESE, *ESE?

---

***IDN?** Identification Query

**Availability:** Always

**Command Syntax:** *IDN?

**Response:** <Manufacturer>,<Model>,<Serial #>,<Firmware Level>

**Response Example:** Cryomagnetics,TM-620,2002,2.00

**Serial # Range:** 2000 to 9999 **Firmware Level Range:** 1.00 to 9.99

**Description:** The ***IDN?** command operates per IEEE Std 488.2-1992 by returning the TM-620 manufacturer, model, serial number and firmware level.

**Related Commands:** None

---

***OPC** Operation Complete Command

**Availability:** Always

**Command Syntax:** *OPC

**Description:** The ***OPC** command operates per IEEE Std 488.2-1992 by placing the Operation Complete message in the Standard Event Status Register (ESR). The TM-620 processes each command as it is received and does not defer any commands for later processing.

**Related Commands:** *OPC?

---

***OPC?** Operation Complete Query

**Availability:** Always

**Command Syntax:** *OPC?

**Description:** The ***OPC** command operates per IEEE Std 488.2-1992 by placing an ASCII character "1" in the output queue since the TM-620 does not defer any commands for later processing.

**Related Commands:** *OPC

---

***RST** Reset Command

**Availability:** Always

**Command Syntax:** *RST [hw]

**Default Parameter:** blank **Parameter Range:** blank or hw

**Description:** The ***RST** command operates per IEEE Std 488.2-1992 by returning the TM-620 to its power up configuration. This selects channel 1 as the default channel, terminates any refill sequence in progress, and clears any refill timeouts that may have occurred. If the optional parameter <hw> is provided, the instrument will perform a hardware reset one second later instead of returning to power up configuration as required by the Standard.

**Related Commands:** None

---

***SRE** Service Request Enable Command

**Availability:** Always

**Command Syntax:** *SRE <mask>

**Example:** *SRE 255

**Default Parameter:** 0 **Parameter Range:** 0 to 255

**Description:** The ***SRE** command operates per IEEE Std 488.2-1992 by setting the specified mask into the Service Request Enable Register (SRE).

**Related Commands:** *SRE?

---

***SRE?** Service Request Enable Query

**Availability:** Always

**Command Syntax:** *SRE?

**Response:** <SRE Mask>

**Response Example:** 255 **Response Range:** 0 to 255

**Description:** The ***SRE?** command operates per IEEE Std 488.2-1992 by returning the mask set in the Service Request Enable Register (SRE) by a prior *SRE command.

**Related Commands:** *SRE

***STB?** Read Status Byte Query

**Availability:** Always

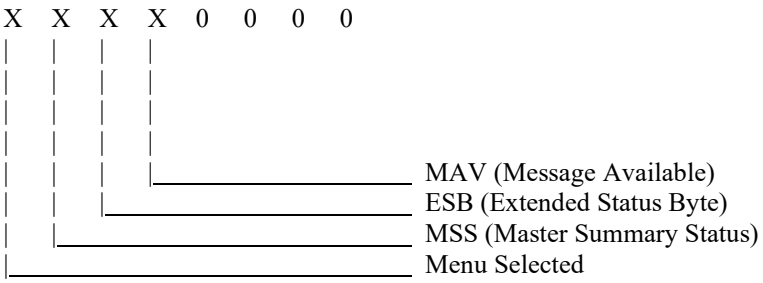
**Command Syntax:** *STB?

**Response:** <Status Byte>

**Response Example:** 65 **Response Range:** 0 to 255

**Description:** The ***STB?** command operates per IEEE Std 488.2-1992 by returning the Status Byte.

Status Byte Bit Allocations:




---

*** TST?** Self-Test Query

**Availability:** Always

**Command Syntax:** *TST?

**Response:** <Self test status>

**Response Example:** 1 **Response Range:** 1

**Description:** The ***TST?** command operates per IEEE Std 488.2-1992 by returning the self-test status. Explicit tests are not performed in response to this command, but a 1 is returned for compliance with the specification.

**Related Commands:** None

---

*** WAI** Wait-to-Continue Command

**Availability:** Always

**Command Syntax:** *WAI

**Description:** The ***WAI?** command operates per IEEE Std 488.2-1992 by accepting the command without generating an error. Since the TM-620 only implements sequential commands the no-operation-pending flag is always TRUE.

**Related Commands:** OPC, *OPC?

---

# 6. Line Voltage Controller Module – Option 4

## 6.1. Overview

The Line Voltage Controller Module enables the TM-620 to control one or two 115/230 VAC loads up to 1 Amp each using the TM-620 Low and High setpoints. Section 5.5, Automatic Refill, describes operation of the TM-620 in automatic refill applications. The outputs are labeled channel 1 and channel 2 and they are controlled by the respective channels of the TM-620.

## 6.2. Connections

An interconnection cable is provided with the Line Voltage Controller Module to connect the TM-620 to the Line Voltage Controller Module and to the sensors. The Switchcraft connector shown in **Figure 2** attaches to the TM-620, the DB-9F attaches to the Line Voltage Controller Output Module. Individual sensor connectors on the cable for channel 1 and channel 2 are labeled. Output connections are standard 115V or 230V output sockets as specified per order.

**DB-9M Pinout**

Pin 1 - Channel 1 control input (0V - enabled, open - disabled)

Pin 3 - Channel 2 control input (0V - enabled, open - disabled)

Pin 6 - +15V input (10 ma max)

Pin 9 - Ground

## 6.3. Fuses

Each output is individually fused on the rear panel of the module with a user replaceable 2 amp 250VAC fuse. Slow blow fuses should not be used.

## 6.4. Theory of Operation

The 'hot' side of each output is individually switched using an opto-isolated solid-state switch rated for 20-500Hz operation. These switches exhibit a 1 mA off-state leakage current, which will be observed as 90-100 VAC if the output is checked with a voltmeter with no load attached to the output.

# 7. Factory Calibration / Firmware Updates

## 7.1. Overview

The TM-620 is initialized and fully calibrated at the factory prior to delivery to establish sensor excitation levels and to calibrate hardware (such as analog outputs). Recalibration should not be necessary. If you believe your TM-620 requires recalibration, contact Cryomagnetics for assistance.

********** **WARNING** **********

***Excitation voltages for Temperature sensors can be dangerous.***

***Proper care must be exercised to ensure safety of personnel and equipment.***

***Load resistors and/or sensors must be attached to perform the calibration in most cases.***

***Power MUST be removed while making ALL connections.***

**********

## 7.2. Firmware Updates

Firmware updates for the TM-620 may be installed without returning the unit to the factory. The procedure involves downloading a firmware upgrade file from the Cryomagnetics website and then transferring the software to the TM-620 through the Ethernet port of the instrument. Contact Cryomagnetics for information and instructions on upgrading the firmware of your TM-620.

## 7.3. Built In Sensor Temperature Curves

| Sensor Type | RO-600 | PT100 |
|---|---|---|
| Temp (K) | R (Ω) | R (Ω) |
| 2 | 1723.48 | |
| 3 | 1507.58 | |
| 4 | 1394.87 | 1.55 |
| 5 | 1325.01 | |
| 6 | 1277.29 | |
| 7 | 1242.56 | |
| 8 | 1216.56 | |
| 9 | 1195.31 | |
| 10 | 1178.49 | 1.65 |
| 11 | 1164.61 | |
| 12 | 1152.97 | |
| 13 | 1143.05 | |
| 14 | 1134.51 | |
| 15 | 1127.06 | 1.83 |
| 16 | 1120.53 | |
| 17 | 1114.74 | |
| 18 | 1109.57 | |
| 19 | 1104.94 | |
| 20 | 1100.94 | |
| 21 | 1097.13 | |
| 22 | 1093.63 | |
| 24 | 1087.45 | |
| 25 | 1084.70 | 2.83 |
| 26 | 1082.14 | |
| 30 | 1073.43 | 3.80 |
| 35 | 1065.04 | |
| 40 | 1058.47 | 6.12 |
| 45 | 1053.15 | |
| 50 | 1048.71 | 9.30 |

| | RO-600 | PT100 |
|---|---|---|
| Temp (K) | R (Ω) | R (Ω) |
| 60 | 1041.67 | 13.00 |
| 65 | 1038.81 | 14.50 |
| 70 | 1036.26 | 17.00 |
| 75 | 1033.98 | 18.60 |
| 77 | 1033.14 | 20.10 |
| 80 | 1031.92 | 21.30 |
| 90 | 1028.33 | 25.80 |
| 100 | 1025.28 | 30.00 |
| 110 | 1022.65 | 34.20 |
| 120 | 1020.34 | 38.50 |
| 130 | 1018.30 | 42.50 |
| 140 | 1016.46 | 46.60 |
| 150 | 1014.80 | 50.70 |
| 160 | 1013.29 | 54.80 |
| 170 | 1011.91 | 59.00 |
| 180 | 1010.63 | 63.00 |
| 190 | 1009.45 | 67.00 |
| 200 | 1008.35 | 71.20 |
| 210 | 1007.32 | 75.10 |
| 220 | 1006.36 | 79.00 |
| 230 | 1005.45 | 83.00 |
| 240 | 1004.60 | 87.00 |
| 250 | 1003.79 | 90.90 |
| 260 | 1003.03 | 94.90 |
| 270 | 1002.30 | 98.80 |
| 273 | 1002.09 | 100.00 |
| 280 | 1001.61 | 102.70 |
| 290 | 1000.95 | 106.80 |
| 300 | 1000.32 | 110.50 |

# 8. Limited Warranty Policy

Cryomagnetics, Incorporated. ('Cryomagnetics') warrants its products to be free from defects in materials and workmanship. This warranty shall be effective for two (2) years after the date of shipment from Cryomagnetics. NOTE: The two-year warranty period does not apply to Commercial-Off-The-Shelf (COTS) items which carry specific manufacturer's warranties. Cryomagnetics reserves the right to elect to repair, replace, or give credit for the purchase price of any product subject to warranty adjustment. Return of all products for warranty adjustment shall be FOB Oak Ridge, Tennessee, and must have prior authorization for such return from an authorized Cryomagnetics representative.

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

In any event, the liability of Cryomagnetics, Incorporated. is strictly limited to the purchase price of the equipment supplied by Cryomagnetics, Incorporated. Cryomagnetics shall not assume liability for any consequential damages.

# 9. Factory Calibrations, Installed Options and Certification

**TM-620 Serial Number:** _____

**Input Channel A:**

Excitation: 1mA _____ 100 µA _____ 10µA: _____

Sensor: PT100 _____ RO600 _____ Other: _____

Alarm Hi: _____

Alarm Lo: _____

**Input Channel B:**

Excitation: 1mA _____ 100 µA _____ 10µA: _____

Sensor: PT100 _____ RO600 _____ Other: _____

Alarm Hi: _____

Alarm Lo: _____

**Input Channel C:**

Excitation: 1mA _____ 100 µA _____ 10µA: _____

Sensor: PT100 _____ RO600 _____ Other: _____

Alarm Hi: _____

Alarm Lo: _____

**Input Channel D:**

Excitation: 1mA _____ 100 µA _____ 10µA: _____

Sensor: PT100 _____ RO600 _____ Other: _____

Alarm Hi: _____

Alarm Lo: _____

**Computer Interface Installed:** IEEE-488.2 (Option 1) : _____ RS-232(Option 2): _____

Notes: _____

_____

_____

_____

Certified: _____

Date: _____